

NULATO RIVER SALMON ESCAPEMENT PROJECT, 1999



By

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and

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ABSTRACT

Summer chum salmon migrating into the Nulato River were counted using counting towers to estimate the spawning abundance in 1999. Before 1994, salmon escapements to the Nulato River were previously indexed only by aerial surveys. Beginning in 1994, a cooperative tower counting project was formed by the Tanana Chiefs Council, Nulato Tribal Council and the Alaska Department of Fish and Game. The Nulato Tribal Council and the Alaska Department of Fish and Game estimated the daily passage of summer chum salmon *Oncorhynchus keta* and chinook salmon *O. tshawytscha* using visual observations from towers during the period June 24 to July 29, 1999. Counting was interrupted at 0400 on June 27 until 0900 on June 27, from 0000 on July 21 to 0000 on July 23, and from 0400 on July 26 until 0000 on July 28 because high and turbid water caused poor counting conditions. Missed counting periods were interpolated for chum salmon and chinook salmon. Total estimated escapements into the Nulato River were 1,943 chinook salmon and 30,283 summer chum salmon. Observations of commercial harvests, aerial survey data, and other escapement projects indicate that chinook salmon runs to the Yukon River were well below average. However, conservative management steps were taken and escapement goals were generally achieved in the Alaska portion of the drainage, but border passage estimates indicate escapements into Canadian spawning tributaries were not achieved. Overall, summer chum salmon escapements into Yukon River spawning grounds were below average.

INTRODUCTION

The goal of the Nulato River Tower project is to provide area managers an inseason escapement index for the upper portion of the Yukon River District 4 management area. This project also assesses the age and sex composition of the summer chum salmon escapement into the Nulato River.

Historical aerial survey indices indicate summer chum salmon returning to the Nulato River (river kilometer [rkm] 777) may be the largest producer of summer chum salmon above the Anvik River (rkm 512) (Sandone 1995). Spawning chinook salmon also utilize the Nulato River. Some pink and coho salmon have been reported to spawn in the Nulato River but do not spawn in significant numbers. Management of subsistence and commercially targeted salmon species requires reliable run strength and run timing information from harvests and escapement information as salmon migrate through Yukon River districts. Ground based escapement projects throughout the Yukon River drainage are typically operated on tributaries that are easily accessible and/or are considered to be an important spawning tributary. These escapement projects provide researchers and managers quality escapement information; and age, sex and size information that can be used for management of Yukon River salmon resources.

Nulato River escapements were previously indexed using aerial survey methodology. Aerial survey methods are inexpensive compared to ground based projects but sacrifice quality information. Aerial survey indices are susceptible to a host of factors, which influence the quality of the data, therefore do not provide accurate escapement estimates of chinook or summer chum migrating into the Nulato River. There is a lack of quality historical escapement information for Nulato River chinook and summer chum salmon. Without this information, it is difficult to determine whether escapement objectives are being met in this portion of the Yukon River. Without a historical database, determination of what the escapement objectives should be is also difficult. Pilot Station Sonar, test fishing indices, age and sex composition information, and commercial and subsistence harvests provide run strength and run timing information of salmon migrating up the Yukon River mainstem. However, these assessment projects and their indices do not provide quality escapement information for specific tributaries being used to index salmon runs in various districts of the Yukon River.

The Yukon River drainage supports major stocks of chinook salmon *Oncorhynchus tshawytscha*, summer and fall run chum salmon *O. keta*, and coho salmon *O. kisutch*. These species contribute to commercial and subsistence fisheries throughout the Yukon River drainage. Pink salmon *O. gorbuscha* and sockeye salmon *O. nerka* are also indigenous to the Yukon River. Pink salmon return to lower drainage tributaries and typically have stronger runs in even numbered years. Sockeye salmon are documented less frequently. Neither of the two later species are harvested commercially or targeted to any extent for subsistence use. Summer chum salmon are distinguished from fall chum salmon by their earlier entry timing (early June to mid-July) into the Yukon River. Summer chum salmon are smaller in size with spawning distributions into lower and middle Yukon River drainages. Fall chum salmon enter the Yukon River from mid-July to the first of September, are larger, and spawn primarily in middle to upper portions of the Yukon River drainage.

Before 1994, there were relatively few projects that provided spawning escapement information for the various Yukon River salmon stocks. Lower river test fishing catch rates, inseason passage estimates from Pilot Station Sonar (rkm 198) and the Anvik River sonar project (rkm 512) provided most of the available information used to make management decisions concerning commercial and subsistence harvests of summer chum salmon in District 4 (Figure 1).

Salmon returning to the Nulato River are most likely harvested in commercial and subsistence fisheries in coastal areas near the Yukon River delta and throughout the mainstem Yukon River. These areas include the Coastal District, Districts 1, 2, and 3 and most of District 4 (Figure 1). There was not an inseason salmon escapement, monitoring project within the upper portion of District 4 to serve as an index for run size and quality (sex composition) of spawning escapements in that portion of the river prior to the Nulato River tower project. Federal agencies and private organizations have increased their involvement and participation by developing and implementing additional spawning escapement and assessment projects. These projects provide managers inseason escapement information necessary to manage for escapements. Operation of an inseason escapement monitoring project for summer chum salmon within the upper portion of District 4 would serve as an index for the middle Yukon River area and provide fishery managers additional information concerning the size and quality of spawning escapement in this area. Additional stock identification studies for mixed stock fisheries could provide information to develop stream specific biological escapement goals.

A thorough review of the Nulato River and probable contribution of salmon production from this stream to the Yukon River is presented in the report *Nulato River Salmon Escapement Project, 1994* (Sandone 1995), which was the first year of operation. With the exception of 1995, Nulato River salmon escapement reports have been written annually (Headlee 1996; Paulus 1997; Paulus *et. al.* 2001; Lingnau and De Hovanisian 2001). The 1995 field project data was reported only as a brief summary by Paul Headlee, Water Resource Specialist, TCC. This report presents information gathered during the 1999 field season.

Nulato River Escapement Assessment

The Nulato River is one of the department's primary aerial survey index areas for assessment of the relative magnitude of chinook and summer chum salmon spawning escapement. All escapement goals pertaining to the Nulato River were, and presently are, based on aerial survey counts of salmon.

Nulato River escapement goals for chinook and summer chum salmon were first established in 1981 (Buklis 1993). For summer chum salmon, an escapement goal range of 33,700 to 78,400 aerial survey counts was initially proposed for the entire Nulato River drainage. This aerial survey goal was modified several times until 1990 when a minimum summer chum salmon goal of 53,000 was established in 1990 (Bergstrom, *et al.* 1992). No escapement goal was established for the South Fork Nulato River (Geiger *et al.* 1984). The various aerial survey-based escapement goals have been met only once since initially established (1986). However, survey conditions have not been acceptable in some years.

A chinook salmon aerial survey based escapement goal range of 400 to 1,100 was proposed in 1981 for the entire Nulato River (Buklis 1993). Similar to summer chum salmon aerial survey goals, this goal went through several changes (Sandone 1995). Chinook salmon escapement goals for the Yukon River were reevaluated in the spring of 1991 and were made effective for the 1992 season (Buklis 1993). At that time, minimum interim escapement goals for chinook salmon, based on aerial survey counts, were established for both forks: 800 for the North Fork and 500 for the South Fork.

Since data gathered from ground based sources (e.g., tower and weir counts, mark-recapture estimates) are considered more reliable than aerial survey data, ground based escapement goals will first be evaluated using such sources having at least 5 years of information. Aerial survey data will be secondarily used when ground based sources are limited or unavailable. Although this was the sixth year of ground based escapement estimates for the Nulato River, there is not enough information necessary to develop a Biological Escapement Goal (BEG) for either chinook or summer chum salmon spawning into the Nulato River. Information from the tower counting project may be used to re-evaluate the current escapement objectives for the Nulato River in the future.

Study Area

The Nulato River is a narrow river with a substrate consisting mainly of gravel and cobble. The river is formed from two main branches, the North Fork and South Fork, which converge approximately 9 kilometer (km) above its mouth. Both forks of the Nulato River originate at an elevation of approximately 600 meter (m). From its source, the South Fork flows in a northeasterly and easterly direction about 98 km to the confluence with the North Fork. From its source, the North Fork, mostly flows in a northeasterly and easterly direction and is approximately 114 km long. The North Fork drainage includes the Kalasik Creek drainage, approximately 54 km in length. The mainstem Nulato River joins the Yukon River at rkm 777 at an approximate elevation of 33 m (Sandone 1995).

The Nulato River tower site is located approximately 5 km upstream of the confluence of the Nulato and Yukon Rivers (Figure 2). The water is typically clear with some brown (tannic) staining from peat and organic material along the watershed. Most of the chum salmon spawning area is upstream of the tower site.

Objectives

The objectives of this study were to:

1. Estimate the total escapement of summer chum and chinook salmon into the Nulato River using tower-counting methodology;
2. Estimate the age and sex composition of the summer chum spawning population;
3. Monitor climatological and hydrological conditions at the tower site.

METHODS

Site Selection and Preparation

The current site was selected in 1994 (Figure 2) after completing a reconnaissance of the mainstem Nulato River. The criteria used for selection included: 1) Location below most, if not all, chum salmon spawning areas; 2) A single, relatively narrow channel; and 3) Relatively shallow river depth to facilitate observation of migrating salmon from the towers. The south side (right bank) of the river is a wide gravel bar with gradual decline and the north side (left bank) is characterized as a cut bank with a rapid decline.

On the left bank (north side) of the river, a single section of 3 m high steel scaffold tower was erected. On the south side (right bank) of the river, two sections of scaffold were combined to make a 6 m high tower. The right bank tower was placed in the river to reduce the width of the counting area. A 15 m long weir of wire fencing and T-stakes extended from the right bank to the tower to divert fish into the counting area. To make the fish easier to see, light-colored empty sandbags were attached to a bank-to-bank cable weighted with sandbags. Sandbags were also placed on the flash panel to keep it from flagging. This light-colored background improved the ability of the crew to see and count fish. Observers wore polarized glasses to reduce glare. During the darkest hours, several lights suspended on a line across the river illuminated the counting area.

Escapement Estimation Sampling

Tower counting operations were conducted 7 days a week, 24 hours a day, for a 15-minute period each hour on each bank. The left bank counting period began at the top of the hour and the right bank began at the bottom of the hour. The observer counted fish passage by species and noted the direction of movement (upstream or downstream). Hand-held tally counters were used to record the observed tower counts. These counts were then transferred to data forms immediately after completion of a shift (Appendix A). Each count was expanded for each hour and each bank by dividing the count by the proportion of the hour counted. Missed counts were estimated by averaging the counts for the hours before and after the missed hourly count. When salmon were not counted for a portion of a day, the expanded total daily count for that day was estimated by dividing the expanded partial daily count by the mean proportion of the count, for the corresponding hours for the day before and day after having full 24-hour counts. When counting was not conducted for a full day, the salmon passage estimate for that day was calculated as the mean salmon passage for the day before and after. When counting was not conducted for more than one full day, the passage for those days were estimated by interpolating between the last full day and first full day of counts after counting resumed.

The daily passage for each bank was calculated by summing the expanded hourly counts for each species, for each bank. The total daily passage estimate for each species was the sum of the expanded count for each bank.

Age-Sex-Size Sampling

When the Nulato River tower project was initiated in 1994, dates needed to be established to define sampling strata for collecting age-sex-length (ASL) information. Run timing information did not exist for the Nulato River. Aerial survey information seemed to indicate, however, that the timing of peak abundance for summer chum salmon in the Nulato River was historically similar to that of the Anvik River for which sonar daily passage estimates were available dating back to 1979 (Sandone, 1995). Strata periods were initially selected for the Nulato River based on those used on the Anvik River, and were described as: early, June 20 to July 3; early-middle, July 4-8; late-middle, July 9-13 and late, July 14-26 (Sandone 1995). These strata were altered postseason in 2001 to increase the number of samples used for each stratum.

The sample goal for each species was based on 95% precision with 10% accuracy for each time stratum. The season ASL sample goal was set at 640 chum salmon and all chinook salmon, with 160 chum salmon sampled in each of the strata described above. Beyond the required ASL sample, beach seining continues until an additional 200 chum salmon per stratum were caught and observed for male-female ratio. The additional 200 fish per strata, combined with the 160 summer chum salmon per strata, would yield a total sex ratio sample goal of 1,480 fish for the season on the Nulato River to define the quality of the escapement. For chinook salmon escapement, a sample size of 198 fish per stratum was the season goal based on the number of age classes that were expected in the run (Bromaghin 1993). While beach seine catches were expected to yield the desired total chum salmon sample, the chinook salmon sample would unlikely be achieved because of the difficulty of catching chinook salmon by beach seine.

A beach seine 31 m long, 66 meshes deep of 6.35 centimeter (cm) mesh, was used to catch salmon for ASL samples. Data such as date, time of seine, number and sex of fish were recorded (Appendix A) Captured salmon were identified by species and sex, measured to the nearest 5 millimeter (mm) (mid-eye to fork-of-tail), sampled for scales and adipose fin-clipped to prevent re-sampling. Scales were taken from an area posterior to the base of the dorsal fin and above the lateral line on the left side of the fish (Clutter and Whitesel 1956). One scale was taken from chum salmon and three scales were taken from chinook salmon. Scales were wiped clean to remove slime and tissue and affixed to a gum-surfaced scale card with numbers that corresponded to recording form. The scales were processed and aged post-season, and ASL data compiled and summarized.

Hydrological and Climatological Sampling

Climatological and hydrological data were collected at approximately 1800 hours each day at the campsite. Relative stream depth was monitored on a staff gauge marked in 0.1-foot increments with measurements subsequently converted to cm. Water temperature was measured in Celsius (°C) near shore at a depth of about 0.5 m. Daily maximum and minimum air temperatures were recorded in °C using a "high-low" thermometer. Subjective notes describing wind speed and direction, cloud cover and precipitation were recorded by the crew (Appendix A).

RESULTS AND DISCUSSION

Escapement Estimation

Counting towers were operated on each bank of the Nulato River from June 24 to July 29 in 1999 (Table 1). Counting was interrupted at 0400 on June 27 until 0900 on June 27, from 0000 on July 21 to 0000 on July 23, and from 0400 on July 26 until 0000 on July 28 because high and turbid water caused poor counting conditions. Estimates were calculated for summer chum and chinook salmon by interpolating counts as described under the Methods section. Expanded hourly counts by day and by bank for chinook and summer chum salmon are presented in Appendix B.

The water level and turbidity at the counting site varied throughout the 1999 field season. Two flood events were noted, one at the onset of the project, another approximately four weeks later near the very end of the field season. These high water events did not hamper beach seining.

Spatial distribution of summer chum salmon is normally close to the riverbank, which brings them close to the towers where they are easier to observe and count. Therefore, over the course of the season, counts of summer chum salmon are thought to be a good estimate of the total escapement passage. In 1994, Sandone (1995) observed that chinook salmon typically travel in the deepest part of the channel or near the middle of the river, where many were probably not seen and counted. Therefore the escapement estimate of chinook salmon is to be considered a conservative estimate and below the actual escapement.

Chinook Salmon

The chinook salmon escapement estimate into the Nulato River was 686 for the right bank and 1,257 for the left bank for a total 1,943 chinook salmon (Table 1). No chinook salmon were observed until the tenth day of tower operations. Figure 3 illustrates the relative passage rate estimate by day for each bank. A degree of bank orientation was observed in 1999 with 35% of the estimated total passage observed on the right bank and 65% observed on the left bank.

The first quartile day of passage occurred on July 10 (Table 2), one day later than the 5-year average (1994-1998) (Table 3, Figure 4) of July 9. The median day occurred on July 14, one day later than the 5-year average (1994-1998) of July 13, and the last quartile occurred on July 19 two days later than the 5-year average (1994-1998) of July 17. The total chinook salmon estimated escapement was 6% below the five-year average. Chinook salmon exhibited a diurnal migratory behavior in 1999. Chinook salmon generally migrated upriver with the highest passage typically occurring between 1300 and 2300 hours and the lowest passage occurring between 0000 and 0900 hours (Table 4, Figure 5).

In 1999, the aerial survey escapement goal for chinook salmon was 500 for the South Fork and 800 for the North Fork. No aerial survey was flown in 1999 because of poor weather conditions.

Summer Chum Salmon

The estimated summer chum salmon escapement from June 24 through July 29 was 15,740 on the right bank and 14,543 on the left bank for a total of 30,283 chum salmon. Expanded data for each bank are presented in Table 1 and Figure 3. This was the lowest escapement estimate during the six years of counting tower operation (Table 5, Figure 4). The first quartile day of passage occurred on July 7 (Table 2), seven days later than the 5-year average (1994-1998) of July 2 (Table 5). The median day occurred on July 11, four days later than the 5-year average (1994-1998) of July 7, and the last quartile occurred on July 16 five days later than the 5-year average (1994-1998) of July 11.

Passage of summer chum salmon in the Nulato River in 1999 demonstrated a distinct diurnal pattern. This pattern has also been previously noted in this system and on the Anvik River (Sandone 1995). Table 1 and Figure 3 illustrates the spatial distribution with 51% of the run counted on the right bank, the side of the river with the wide gravel bar and gradual decline, and the remaining fish passing the left bank which is characterized with a steep decline. Table 4 and Figure 5 illustrates the diurnal pattern with hourly counts increasing steadily in the afternoon on both banks, typically peaking between 2100 and 0100 hours, then decreasing to the lowest passage rate period occurring between 0300 and 1300 hours.

The distribution of 1999 counts by day verifies observations by the crew that the preponderance of the run passed the tower site during counting operations, and counts increased during the first few days and tapered off during the last week (Table 2, Figure 3). During the weak run observed in 1999, daily passage estimates of summer chum salmon surpassed 2,000 fish only six times. Fifty percent of the run occurred during the ten days between the 1st and 3rd quartile out of the 35-day counting period.

Sandone (1995) evaluated run timing information using test fishing catch rates, Yukon River sonar, and escapements to the Anvik, Kaltag, and Nulato Rivers to determine run timing relationships for summer chum salmon migrating into the Nulato River. Comparisons between historical relative abundance data from aerial surveys and the 1994 Nulato River tower data suggested that run timing into the three spawning escapement tributaries was similar. Sandone (1995) cites swimming speed analyses using lower Yukon River test fishing data and Anvik river sonar data, summer chum salmon have an estimated average travel speed of 42 km per day. This statistic indicated that fish spawning farther upriver passed by the Yukon River sonar site earlier than those spawning in tributaries lower in the river near the downstream, which entered the river later. No aerial survey was conducted because of poor weather. Therefore, no comparisons could be made between tower escapement estimates with aerial survey estimates in 1998.

Age-Sex-Size

Nulato escapement ASL sampling in 1999 was completed on 653 summer chum salmon captured by beach seine. Sampling was done at a site approximately 100 m upstream from the north (left) bank tower during the early portion of the season. For the pooled sample weighted by escapement, 57.5 % were age-0.3 fish, 35.2% were age-0.4 fish, 3.6% were age-0.5 fish, 3.3% were age-0.6 fish with the remaining 0.3% being age 0.2-fish (Table 6). The weighted sex ratio

was 63.0% females and 37.0% males. Mean lengths ranged from 552.5 mm to 581.2 mm for females and 566.1 mm to 602.8 mm for males. For both males and females, age-0.4 had the greatest mean length, followed by age-0.5 and age-0.3 fish. While the first two strata had a higher percentage of age-0.4 fish than age-0.3 fish, age-0.3 fish predominated in the final two strata followed by age-0.4 fish and to a lesser degree age-0.5 and 0.6 fish. The percentage of females rose through the season, with a greater percentage of males in the first strata giving way to a preponderance of females in the final three strata. Females were predominant across all age classes (Figure 6, Appendix C).

Too few chinook salmon were caught in the beach seines to make an analysis of age and sex composition of the chinook run. No carcass sampling project was conducted on the Nulato River, therefore no escapement age and sex for chinook salmon information is available.

Hydrology and Climate

For most tributaries of the Yukon River, the water is usually highest during or shortly after breakup, and generally continues to drop during the summer as the snow pack decreases. Storage capacity of the Nulato River watershed, appears to be minimal with limited retention of rainfall in the upper areas of the drainage. The Nulato River, similar to the Anvik River, has rapid changes in water depth when substantial rainfall occurs. These flood conditions make counting difficult or impossible because of the suspended solids, detritus, tannic staining, and increased water depth.

Light rainfall for the Nulato River drainage was observed on 16 out of 35 recorded weather days, with nineteen days recording no rainfall (Table 7). The highest water level was recorded on July 21 and the lowest water level was recorded on July 18 (Table 7, Figure 7). Water temperatures ranged from 8.5°C to 15.1°C, a range of 6.6 °C during the season. The range for the low air temperature was from 2.5°C to 14.5°C (a range of 12 °C) and for the high temperature, 13.0°C to 31.0°C, a range of 18.0°C.

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TABLES AND FIGURES

Table 1. Nulato River tower daily expanded counts for chinook and summer chum salmon by bank and total by day, 1999.

Date	Chinook salmon expanded counts			Chum salmon expanded counts		
	Right Bank	Left Bank	Total ^a	Right Bank	Left Bank	Total ^a
24-Jun	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0
28-Jun	0	0	0	0	0	0
29-Jun	0	0	0	0	0	0
30-Jun	0	0	0	0	0	0
1-Jul	0	0	0	4	20	24
2-Jul	0	0	0	16	-4	12
3-Jul	8	0	8	44	212	256
4-Jul	12	36	48	288	432	720
5-Jul	12	4	16	972	992	1,964
6-Jul	24	28	52	940	1,280	2,220
7-Jul	60	44	104	1,420	1,456	2,876
8-Jul	48	46	94	950	1,418	2,368
9-Jul	32	100	132	952	764	1,716
10-Jul	56	98	154	1,176	946	2,122
11-Jul	72	44	116	1,068	1,028	2,096
12-Jul	56	72	128	1,016	1,076	2,092
13-Jul	20	52	72	596	544	1,140
14-Jul	20	56	76	520	488	1,008
15-Jul	36	92	128	784	512	1,296
16-Jul	44	92	136	828	504	1,332
17-Jul	22	72	94	664	540	1,204
18-Jul	20	44	64	568	532	1,100
19-Jul	28	52	80	464	448	912
20-Jul	37	45	82	377	273	650
21-Jul ^b	29	41	70	337	245	582
22-Jul ^b	20	39	59	296	217	513
23-Jul	12	36	48	256	188	444
24-Jul	0	20	20	320	100	420
25-Jul	16	24	40	304	84	388
26-Jul ^b	9	25	34	235	76	311
27-Jul ^b	1	27	28	165	68	233
28-Jul	-4	28	24	96	60	156
29-Jul	-4	40	36	84	44	128
Totals	686	1,257	1,943	15,740	14,543	30,283
Proportions	0.353	0.647		0.520	0.480	

^a The 1st and 3rd quartiles are indicated within the boxed areas and the mid-point is indicated in bold outline.

^b Missed counting periods due to high water were interpolated for summer chum and chinook salmon.

Table 2. Nulato River tower daily and cumulative counts and proportions for chinook and summer chum salmon, 1999.

Date	Chinook Salmon				Summer Chum Salmon			
	Counts		Proportions		Counts		Proportions	
	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.
24-Jun	0	0	0.000	0.000	0	0	0.000	0.000
25-Jun	0	0	0.000	0.000	0	0	0.000	0.000
26-Jun	0	0	0.000	0.000	0	0	0.000	0.000
27-Jun	0	0	0.000	0.000	0	0	0.000	0.000
28-Jun	0	0	0.000	0.000	0	0	0.000	0.000
29-Jun	0	0	0.000	0.000	0	0	0.000	0.000
30-Jun	0	0	0.000	0.000	0	0	0.000	0.000
1-Jul	0	0	0.000	0.000	24	24	0.001	0.001
2-Jul	0	0	0.000	0.000	12	36	0.000	0.001
3-Jul	8	8	0.004	0.004	256	292	0.008	0.010
4-Jul	48	56	0.025	0.029	720	1,012	0.024	0.033
5-Jul	16	72	0.008	0.037	1,964	2,976	0.065	0.098
6-Jul	52	124	0.027	0.064	2,220	5,196	0.073	0.172
7-Jul	104	228	0.054	0.117	2,876	8,072	0.095	0.267
8-Jul	94	322	0.048	0.166	2,368	10,440	0.078	0.345
9-Jul	132	454	0.068	0.234	1,716	12,156	0.057	0.401
10-Jul	154	608	0.079	0.313	2,122	14,278	0.070	0.471
11-Jul	116	724	0.060	0.373	2,096	16,374	0.069	0.541
12-Jul	128	852	0.066	0.438	2,092	18,466	0.069	0.610
13-Jul	72	924	0.037	0.476	1,140	19,606	0.038	0.647
14-Jul	76	1,000	0.039	0.515	1,008	20,614	0.033	0.681
15-Jul	128	1,128	0.066	0.581	1,296	21,910	0.043	0.724
16-Jul	136	1,264	0.070	0.651	1,332	23,242	0.044	0.767
17-Jul	94	1,358	0.048	0.699	1,204	24,446	0.040	0.807
18-Jul	64	1,422	0.033	0.732	1,100	25,546	0.036	0.844
19-Jul	80	1,502	0.041	0.773	912	26,458	0.030	0.874
20-Jul	82	1,584	0.042	0.815	650	27,108	0.021	0.895
21-Jul ^a	70	1,654	0.036	0.851	582	27,690	0.019	0.914
22-Jul ^a	59	1,713	0.030	0.882	513	28,203	0.017	0.931
23-Jul	48	1,761	0.025	0.906	444	28,647	0.015	0.946
24-Jul	20	1,781	0.010	0.917	420	29,067	0.014	0.960
25-Jul	40	1,821	0.021	0.937	388	29,455	0.013	0.973
26-Jul ^a	34	1,855	0.017	0.955	311	29,766	0.010	0.983
27-Jul ^a	28	1,883	0.014	0.969	233	29,999	0.008	0.991
28-Jul	24	1,907	0.012	0.981	156	30,155	0.005	0.996
29-Jul	36	1,943	0.019	1.000	128	30,283	0.004	1.000

^a Missed counting periods due to high water were interpolated for summer chum and chinook salmon.

Table 3. Historic daily and cumulative Nulato River chinook salmon escapement passage estimates, 1994-1999.

Date	1994			1995			1996			1997		
	Daily Counts	Cum. Counts	Cum. Prop.	Daily Counts	Cum. Counts	Cum. Prop.	Daily Counts	Cum. Counts	Cum. Prop.	Daily Counts	Cum. Counts	Cum. Prop.
15-Jun												
16-Jun												
17-Jun												
18-Jun												
19-Jun												
20-Jun										0	0	0.00
21-Jun										0	0	0.00
22-Jun										0	0	0.00
23-Jun										20	20	0.00
24-Jun										16	36	0.01
25-Jun										16	52	0.01
26-Jun				4	4	0.00	12	12	0.02	32	84	0.02
27-Jun				4	8	0.01	12	24	0.03	52	136	0.03
28-Jun				0	8	0.01	8	32	0.04	84	220	0.05
29-Jun				0	8	0.01	4	36	0.05	136	356	0.07
30-Jun				0	8	0.01	8	44	0.06	144	500	0.10
1-Jul				8	16	0.01	12	56	0.07	144	644	0.13
2-Jul				0	16	0.01	8	64	0.08	172	816	0.17
3-Jul				12	28	0.02	13	77	0.10	184	1,000	0.21
4-Jul	0	0	0.00	24	52	0.04	19	96	0.13	344	1,344	0.28
5-Jul	3	3	0.00	64	116	0.08	24	120	0.16	336	1,680	0.35
6-Jul	6	9	0.01	44	160		48	168	0.22	352	2,032	0.42
7-Jul	72	81	0.05	36	196	0.14	40	208	0.28	308	2,340	0.49
8-Jul	72	153	0.09	8	204	0.14	8	216	0.29	368	2,708	0.56
9-Jul	60	213	0.12	16	220	0.16	12	228	0.30	212	2,920	0.61
10-Jul	216	429	0.24	52	272	0.19	108	336	0.44	344	3,264	0.68
11-Jul	208	637	0.35	100	372	0.26	36	372	0.49	128	3,392	0.71
12-Jul	120	757	0.42	52	424	0.30	80	452	0.60	152	3,544	0.74
13-Jul	84	841	0.47	112	536	0.38	52	504	0.67	290	3,834	0.80
14-Jul	92	933	0.52	84	620	0.44	48	552	0.73	108	3,942	0.82
15-Jul	100	1,033	0.58	56	676	0.48	16	568	0.75	252	4,194	0.87
16-Jul	112	1,145	0.64	60	736	0.52	36	604	0.80	184	4,378	0.91
17-Jul	92	1,237	0.69	164	900	0.64	64	668	0.88	108	4,486	0.93
18-Jul	96	1,333	0.74	56	956	0.68	16	684	0.90	52	4,538	0.94
19-Jul	100	1,433	0.80	56	1,012	0.72	16	700	0.93	68	4,606	0.96
20-Jul	104	1,537	0.86	76	1,088	0.77	24	724	0.96	116	4,722	0.98
21-Jul	44	1,581	0.88	92	1,180	0.84	24	748	0.99	44	4,766	0.99
22-Jul	51	1,632	0.91	56	1,236	0.88	8	756	1.00	45	4,811	1.00
23-Jul	40	1,672	0.93	28	1,264	0.90	0	756	1.00			
24-Jul	43	1,715	0.96	72	1,336	0.95	0	756	1.00			
25-Jul	28	1,743	0.97	48	1,384	0.98						
26-Jul	12	1,755	0.98	28	1,412	1.00						
27-Jul	8	1,763	0.98									
28-Jul	32	1,795	1.00									
29-Jul												
30-Jul												
31-Jul												
	1,795			1,412			756			4,811		

(Continued)

Table 3. (Page 2 of 2)

Date	1998 ^a			1999 ^b		
	Daily Counts	Cum. Counts	Cum. Prop.	Daily Counts	Cum. Counts	Cum. Prop.
15-Jun						
16-Jun						
17-Jun						
18-Jun						
19-Jun						
20-Jun						
21-Jun						
22-Jun	0	0	0.00			
23-Jun	0	0	0.00			
24-Jun	8	8	0.01	0	0	0.00
25-Jun	4	12	0.01	0	0	0.00
26-Jun	4	16	0.01	0	0	0.00
27-Jun	28	44	0.03	0	0	0.00
28-Jun	88	132	0.09	0	0	0.00
29-Jun	20	152	0.10	0	0	0.00
30-Jun	12	164	0.11	0	0	0.00
1-Jul	0	164	0.11	0	0	0.00
2-Jul	20	184	0.12	0	0	0.00
3-Jul	0	184	0.12	8	8	0.00
4-Jul	0	184	0.12	48	56	0.03
5-Jul	0	184	0.12	16	72	0.04
6-Jul	36	220	0.15	52	124	0.06
7-Jul	4	224	0.15	104	228	0.12
8-Jul	84	308	0.20	94	322	0.17
9-Jul	60	368	0.24	132	454	0.23
10-Jul	84	452	0.30	154	608	0.31
11-Jul	44	496	0.33	116	724	0.37
12-Jul	92	588	0.39	128	852	0.44
13-Jul	102	690	0.46	72	924	0.48
14-Jul	184	874	0.58	76	1,000	0.51
15-Jul	156	1,030	0.68	128	1,128	0.58
16-Jul	76	1,106	0.74	136	1,264	0.65
17-Jul	20	1,126	0.75	94	1,358	0.70
18-Jul	76	1,202	0.80	64	1,422	0.73
19-Jul	78	1,280	0.85	80	1,502	0.77
20-Jul	72	1,352	0.90	82	1,584	0.82
21-Jul	60	1,412	0.94	70	1,654	0.85
22-Jul	72	1,484	0.99	59	1,713	0.88
23-Jul	20	1,504	1.00	48	1,761	0.91
24-Jul				20	1,781	0.92
25-Jul				40	1,821	0.94
26-Jul				34	1,855	0.95
27-Jul				28	1,883	0.97
28-Jul				24	1,907	0.98
29-Jul				36	1,943	1.00
30-Jul						
31-Jul						
	1,504			1,943		

^a No interpolations were calculated for missed counting period due to a lack of data.

^b Missed counting periods due to high water were interpolated for summer chum and chinook salmon.

Table 4. Season total counts and proportions by hour for Nulato River chinook and summer chum salmon, 1999.

Hour Ending	Chinook Salmon		Summer Chum Salmon	
	Counts	Proportions	Counts	Proportions
1:00	54	0.028	2,136	0.071
2:00	35	0.018	1,521	0.050
3:00	68	0.035	1,278	0.042
4:00	72	0.037	973	0.032
5:00	41	0.021	884	0.029
6:00	41	0.021	915	0.030
7:00	61	0.032	743	0.025
8:00	60	0.031	543	0.018
9:00	82	0.042	575	0.019
10:00	84	0.043	611	0.020
11:00	93	0.048	662	0.022
12:00	116	0.059	673	0.022
13:00	132	0.068	659	0.022
14:00	76	0.039	769	0.025
15:00	105	0.054	767	0.025
16:00	37	0.019	990	0.033
17:00	85	0.044	1,196	0.039
18:00	83	0.043	1,215	0.040
19:00	103	0.053	1,287	0.043
20:00	115	0.059	1,954	0.065
21:00	98	0.050	2,367	0.078
22:00	72	0.037	2,662	0.088
23:00	143	0.074	2,428	0.080
24:00	89	0.046	2,476	0.082
Total	1,943	1.000	30,283	1.000

Table 5. Historic daily and cumulative Nulato River summer chum salmon escapement passage estimates, 1994-1999.

Date	1994			1995			1996			1997		
	Daily Counts	Cum. Counts	Cum. Prop.	Daily Counts	Cum. Counts	Cum. Prop.	Daily Counts	Cum. Counts	Cum. Prop.	Daily Counts	Cum. Counts	Cum. Prop.
15-Jun												
16-Jun												
17-Jun												
18-Jun												
19-Jun												
20-Jun										64	64	0.00
21-Jun				452	452	0.00	700	700	0.01	168	232	0.00
22-Jun				692	1,144	0.00	3,684	4,384	0.03	524	756	0.00
23-Jun				1,056	2,200	0.01	6,612	10,996	0.08	2,344	3,100	0.02
24-Jun				1,880	4,080	0.02	6,680	17,676	0.14	3,816	6,916	0.04
25-Jun				1,612	5,692	0.02	7,196	24,872	0.19	4,856	11,772	0.07
26-Jun				2,044	7,736	0.03	6,792	31,664	0.24	4,592	16,364	0.10
27-Jun				10,884	18,620	0.08	2,082	33,746	0.26	3,868	20,232	0.13
28-Jun				5,196	23,816	0.10	3,812	37,558	0.29	4,816	25,048	0.16
29-Jun	2,001	2,001	0.01	9,184	33,000	0.14	5,542	43,100	0.33	6,972	32,020	0.20
30-Jun	8,355	10,356	0.07	7,188	40,188	0.17	7,271	50,371	0.39	7,916	39,936	0.25
1-Jul	7,898	18,254	0.12	9,716	49,904	0.21	7,104	57,475	0.44	7,656	47,592	0.30
2-Jul	9,604	27,858	0.19	15,110	65,014	0.27	6,076	63,551	0.49	8,900	56,492	0.36
3-Jul	7,601	35,459	0.24	9,068	74,082	0.31	3,624	67,175	0.52	8,596	65,088	0.41
4-Jul	6,708	42,167	0.28	11,064	85,146	0.36	5,484	72,659	0.56	12,432	77,520	0.49
5-Jul	10,188	52,355	0.35	12,700	97,846	0.41	8,320	80,979	0.62	11,432	88,952	0.56
6-Jul	8,092	60,447	0.41	18,504	116,350	0.49	4,968	85,947	0.66	10,748	99,700	0.63
7-Jul	7,008	67,455	0.45	10,704	127,054	0.54	7,460	93,407	0.72	11,368	111,068	0.70
8-Jul	4,704	72,159	0.49	11,960	139,014	0.59	5,728	99,135	0.76	9,944	121,012	0.77
9-Jul	9,232	81,391	0.55	14,008	153,022	0.65	3,664	102,799	0.79	4,664	125,676	0.79
10-Jul	10,744	92,135	0.62	14,004	167,026	0.71	7,104	109,903	0.85	7,388	133,064	0.84
11-Jul	8,776	100,911	0.68	13,684	180,710	0.76	4,144	114,047	0.88	3,756	136,820	0.87
12-Jul	7,327	108,238	0.73	11,356	192,066	0.81	4,224	118,271	0.91	4,153	140,973	0.89
13-Jul	6,931	115,169	0.77	8,660	200,726	0.85	3,888	122,159	0.94	3,558	144,531	0.91
14-Jul	6,535	121,704	0.82	5,172	205,898	0.87	3,132	125,291	0.97	2,256	146,787	0.93
15-Jul	6,140	127,844	0.86	4,232	210,130	0.89	1,920	127,211	0.98	3,016	149,803	0.95
16-Jul	4,440	132,284	0.89	6,728	216,858	0.92	916	128,127	0.99	3,016	152,819	0.97
17-Jul	3,211	135,495	0.91	6,464	223,322	0.94	676	128,803	0.99	2,392	155,211	0.98
18-Jul	3,332	138,827	0.93	3,716	227,038	0.96	520	129,323	1.00	924	156,135	0.99
19-Jul	2,215	141,042	0.95	4,400	231,438	0.98	371	129,694	1.00	1,080	157,215	0.99
20-Jul	1,712	142,754	0.96	3,368	234,806	0.99				760	157,975	1.00
21-Jul	1,208	143,962	0.97	2,084	236,890	1.00				196	158,171	1.00
22-Jul	2,808	146,770	0.99									
23-Jul	1,992	148,762	1.00									
24-Jul												
25-Jul												
26-Jul												
27-Jul												
28-Jul												
29-Jul												
30-Jul												
31-Jul												
Total	148,762			236,890			129,694			158,171		

(Continued)

Table 5. (Page 2 of 2)

Date	1998 ^a			1999 ^b		
	Daily Counts	Cum. Counts	Cum. Prop.	Daily Counts	Cum. Counts	Cum. Prop.
15-Jun						
16-Jun						
17-Jun						
18-Jun						
19-Jun						
20-Jun						
21-Jun						
22-Jun	0	0	0.00			
23-Jun	4	4	0.00			
24-Jun	36	40	0.00	0	0	0.00
25-Jun	56	96	0.00	0	0	0.00
26-Jun	180	276	0.01	0	0	0.00
27-Jun	588	864	0.02	0	0	0.00
28-Jun	770	1,634	0.03	0	0	0.00
29-Jun	722	2,356	0.05	0	0	0.00
30-Jun	716	3,072	0.06	0	0	0.00
1-Jul	708	3,780	0.07	24	24	0.00
2-Jul	496	4,276	0.08	12	36	0.00
3-Jul	1,092	5,369	0.10	256	292	0.01
4-Jul	1,688	7,057	0.14	720	1,012	0.03
5-Jul	2,284	9,342	0.18	1,964	2,976	0.10
6-Jul	2,880	12,222	0.23	2,220	5,196	0.17
7-Jul	1,584	13,806	0.27	2,876	8,072	0.27
8-Jul	2,752	16,558	0.32	2,368	10,440	0.34
9-Jul	2,192	18,750	0.36	1,716	12,156	0.40
10-Jul	4,768	23,518	0.45	2,122	14,278	0.47
11-Jul	2,712	26,230	0.50	2,096	16,374	0.54
12-Jul	2,292	28,522	0.55	2,092	18,466	0.61
13-Jul	4,384	32,906	0.63	1,140	19,606	0.65
14-Jul	4,860	37,766	0.73	1,008	20,614	0.68
15-Jul	3,804	41,570	0.80	1,296	21,910	0.72
16-Jul	2,780	44,350	0.85	1,332	23,242	0.77
17-Jul	1,288	45,638	0.88	1,204	24,446	0.81
18-Jul	1,856	47,494	0.91	1,100	25,546	0.84
19-Jul	734	48,228	0.93	912	26,458	0.87
20-Jul	1,340	49,568	0.95	650	27,108	0.90
21-Jul	1,144	50,712	0.97	582	27,690	0.91
22-Jul	816	51,528	0.99	513	28,203	0.93
23-Jul	513	52,041	1.00	444	28,647	0.95
24-Jul				420	29,067	0.96
25-Jul				388	29,455	0.97
26-Jul				311	29,766	0.98
27-Jul				233	29,999	0.99
28-Jul				156	30,155	1.00
29-Jul				128	30,283	1.00
30-Jul						
31-Jul						
Total	52,041			30,283		

Table 6. Nulato River summer chum salmon weighted age and sex composition and mean length, 1999.

		Brood Year and Age Group					Total
		1996 0.2	1995 0.3	1994 0.4	1993 0.5	1992 0.6	
Female	No. in Escapement	95	11,584	6,104	593	688	19,064
	Percent of Sample	0.3	38.3	20.2	2.0	2.3	63.0
	Mean Length (mm)	560	556.8	581.2	570.4	552.5	
	Std. Deviation	14.1	37.5	33.1	39.6	19.2	
Male	No. in Escapement	0	5,820	4,562	512	325	11,219
	Percent of Sample	0.0	19.2	15.1	1.7	1.1	37.0
	Mean Length (mm)		576.7	602.8	594.5	566.1	
	Std. Deviation		29.7	31.5	46.3	33.3	
Total	No. in Escapement	95	17,404	10,666	1,105	1,013	30,283
	Percent of Sample	0.3	57.5	35.2	3.6	3.3	100.0

Table 7. Nulato River tower project climatological and hydrological observations, 1999.

Date	Time	Precipitation (code\amt)	Wind (Direction and) Velocity	Sky (code)	Temperature (°C)			Water Guage (cm)	Water Color (code)
					Air Min	Air Max	Water		
24-Jun	17:00	0	Calm	2			9.0	1.90	Tr.
25-Jun	18:00	0	S 5	2	11.5	29.5	12.1	1.75	Dk
26-Jun	18:00	0	SE 5	1	13.5	26.0	10.9	1.65	Gr
27-Jun	18:00	0	N 10	2	12.0	29.0	11.7	1.55	Gr
28-Jun	18:00	0	N 10	2	10.5	27.0	12.3	1.45	Gr
29-Jun	18:00	0	E 5	1	11.0	26.0	12.5	1.25	Gr
30-Jun	0:00	0	Calm	1	9.5	28.0	12.2	1.10	Gr
01-Jul	18:00	0	Lt. And Var.	1	9.5	31.0	13.1	1.00	Gr
02-Jul	18:00	0	N 10	1	12.0	30.5	13.4	0.90	Gr
03-Jul	18:00	0	N 5	1	11.0	29.0	13.4	0.80	Gr
04-Jul	16:00	0	S 5	1	9.5	29.0	13.0	0.75	Gr
05-Jul	18:00	0	Calm	3	9.5	27.0	13.2	0.65	Lt
06-Jul	18:00	0	S 10	2	9.0	26.0	13.0	0.60	Lt
07-Jul	18:00	0	N 10	3	9.5	25.0	13.2	0.55	Lt
08-Jul	22:00	0	Lt. And Var.	2	8.5	24.0	13.1	0.45	Lt
09-Jul	18:00	0	W 5	1	9.5	25.0	13.5	0.40	Lt
10-Jul	21:30	0	Calm	2	12.0	30.0	14.7	0.35	Lt
11-Jul	18:00	Trace	NE 10	3	13.0	27.0	14.0	0.35	Lt
12-Jul	19:30	Trace	E 5	2	14.5	29.0	15.1	0.35	Lt
13-Jul	18:00	0	E light	2	12.5	29.0	14.3	0.35	Tr.
14-Jul	18:00	Trace .4 cm	SE 5	3	14.0	29.0	13.4	0.30	Gr
15-Jul	18:00	I/Trace	SW 10	2	10.5	23.0	13.5	0.28	Gr
16-Jul	19:30	I/Trace	S 10	3	8.0	22.0	13.0	0.26	Lt
17-Jul	17:00	I/Trace	S 15	3	7.5	20.0	13.0	0.27	Lt
18-Jul	19:30	I/Trace	S light	4	6.0	25.5	12.8	0.23	Lt
19-Jul	20:30	I/.2 cm	Calm	4	11.0	19.0	11.8	0.24	Lt
20-Jul	19:30	I/.7 cm	SW 15	4	11.0	13.0	11.1	0.79	Tr.
21-Jul	19:30	I/Trace	NW 15	4	8.0	13.0	9.6	1.95	Tr.
22-Jul	18:30	0	N 15	3	6.5	17.0	9.4	1.65	Tr.
23-Jul	18:30	I/Trace	Calm	4	2.5	16.5	8.8	1.30	Gr
24-Jul	18:30	I/.6 cm	Calm	4	7.5	13.0	8.5	1.20	Gr
25-Jul	18:30	I/.4 cm	S 10	4	11.5	16.5	9.5	1.25	Gr
26-Jul	18:30	I/.3 cm	SE 5	4	8.0	14.0	8.6	1.55	Tr.
27-Jul	18:30	I/.05 cm	NW 5	4	7.5	17.0	9.0	1.60	Tr.
28-Jul	18:30	0	Calm	2	6.0	23.0	9.4	1.50	Gr
29-Jul	18:30	I/.1 cm	SW 5	4	11.5	18.0	10.2	1.55	Gr

Codes			
SKY	PRECIPITATION	WATER COLOR	
0 No observation made	I Intermittent rain	Clr	Clear
1 Clear sky, not over 10% cloud cover	R Continuous rain	Dk grn	Dark green
2 Cloud cover not over 50%	S Snow	Lt grn	Light green
3 Cloud cover over 50% of sky	S&R Mixed snow & rain	Br	Brown
4 Completely overcast	H Hail	Dk	Dark Brown
5 Fog or thick haze or smoke	T Thunder showers	Tr	Turbid: murky or glacial

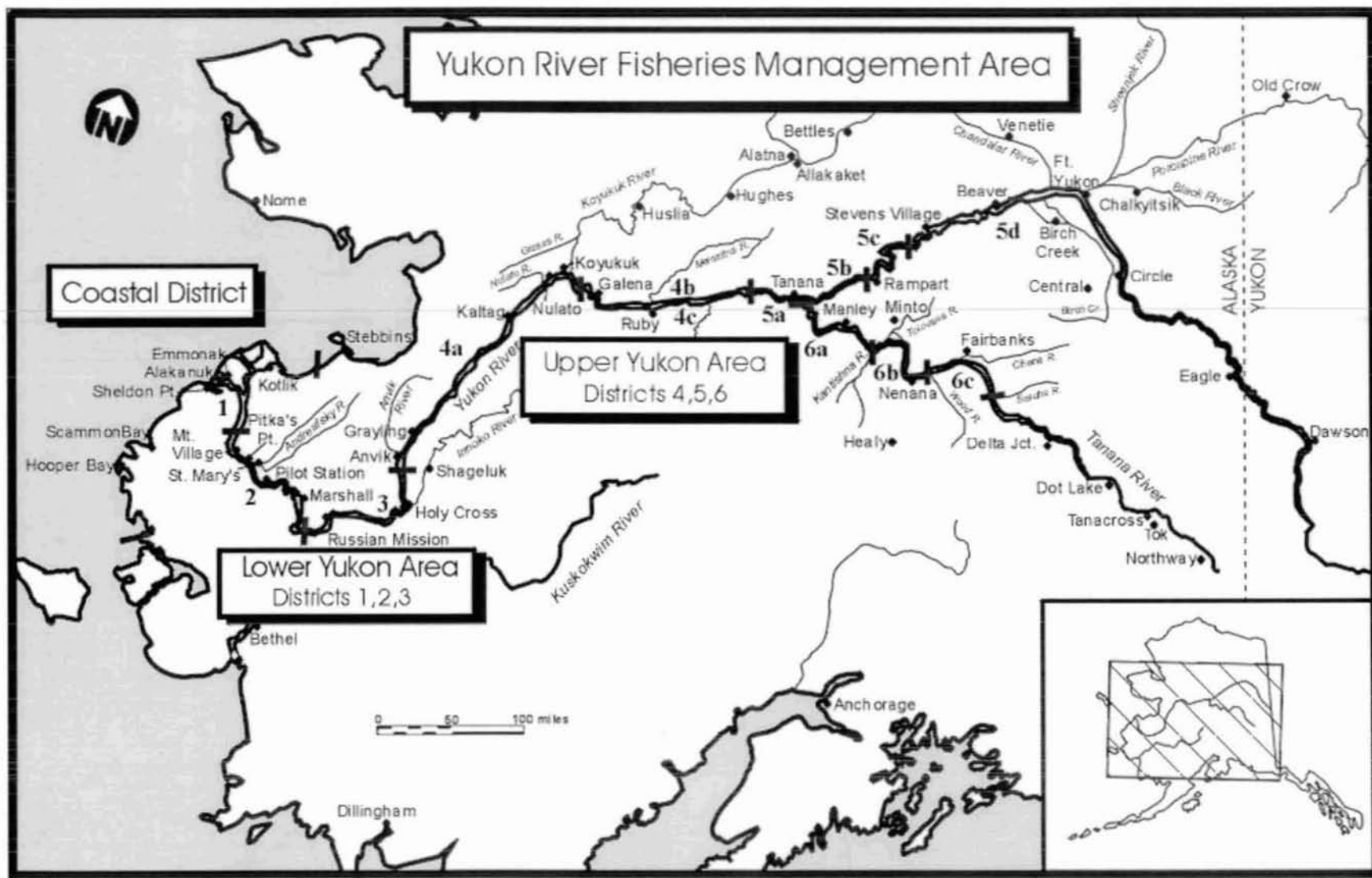


Figure 1. Alaskan portion of the Yukon River showing villages and fishing district boundaries.

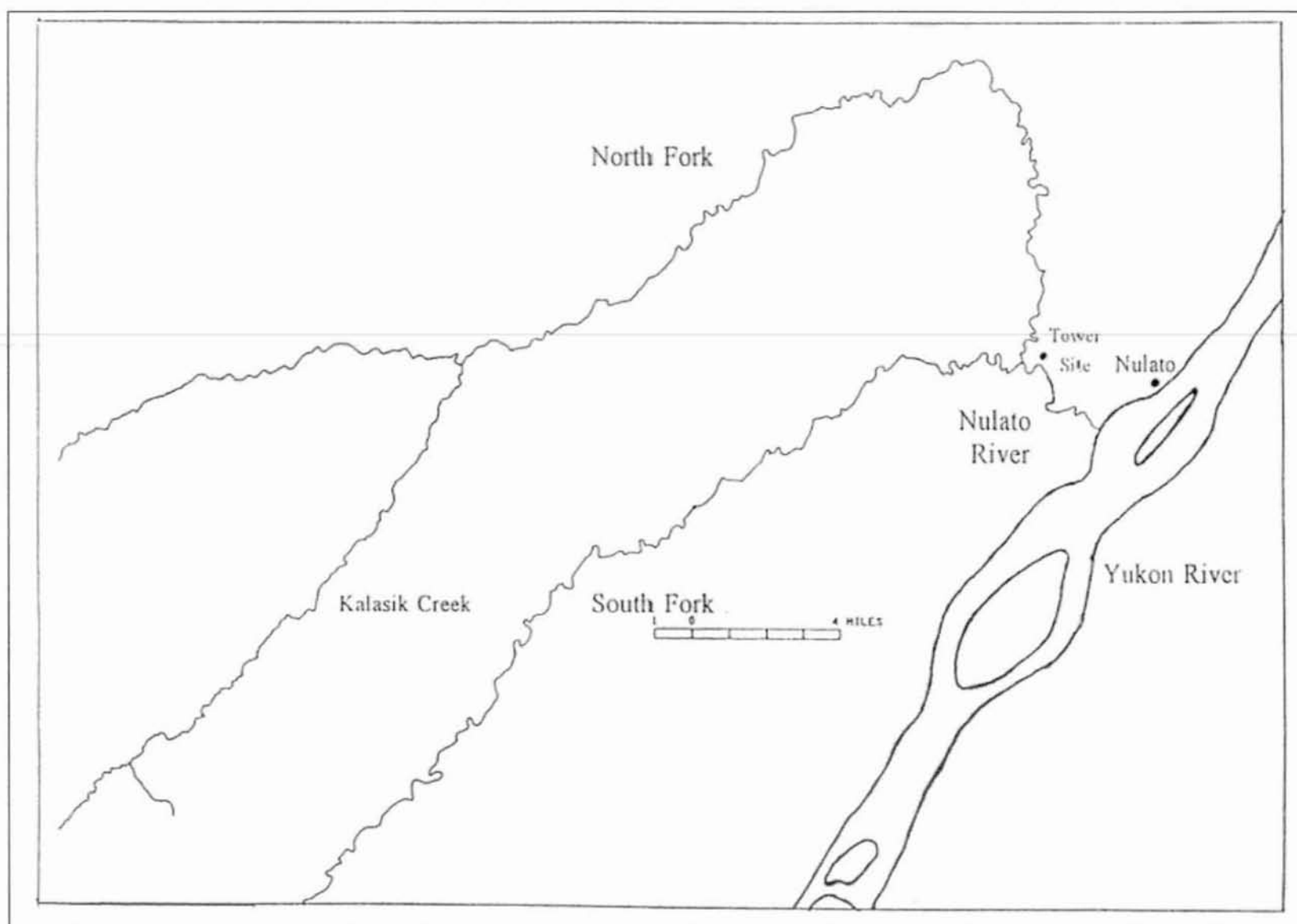


Figure 2. The Nulato River drainage showing the counting tower site.

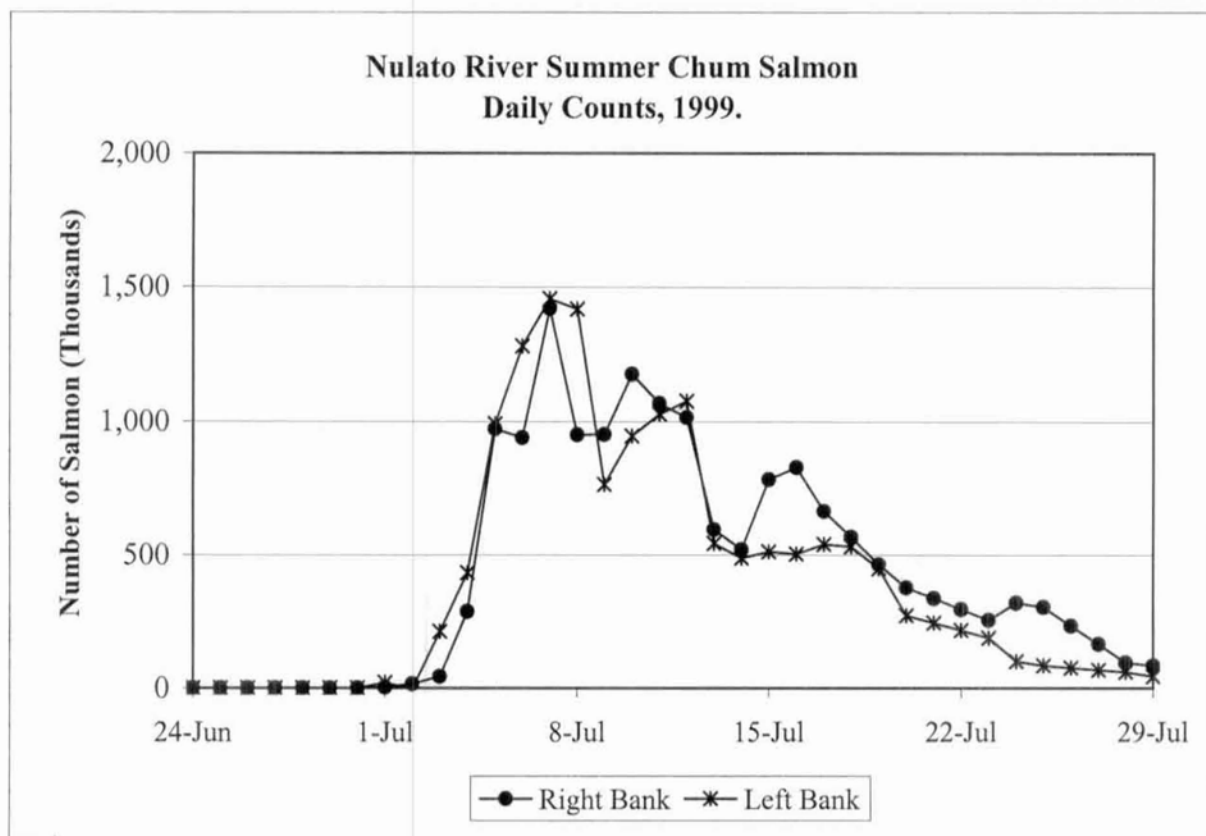
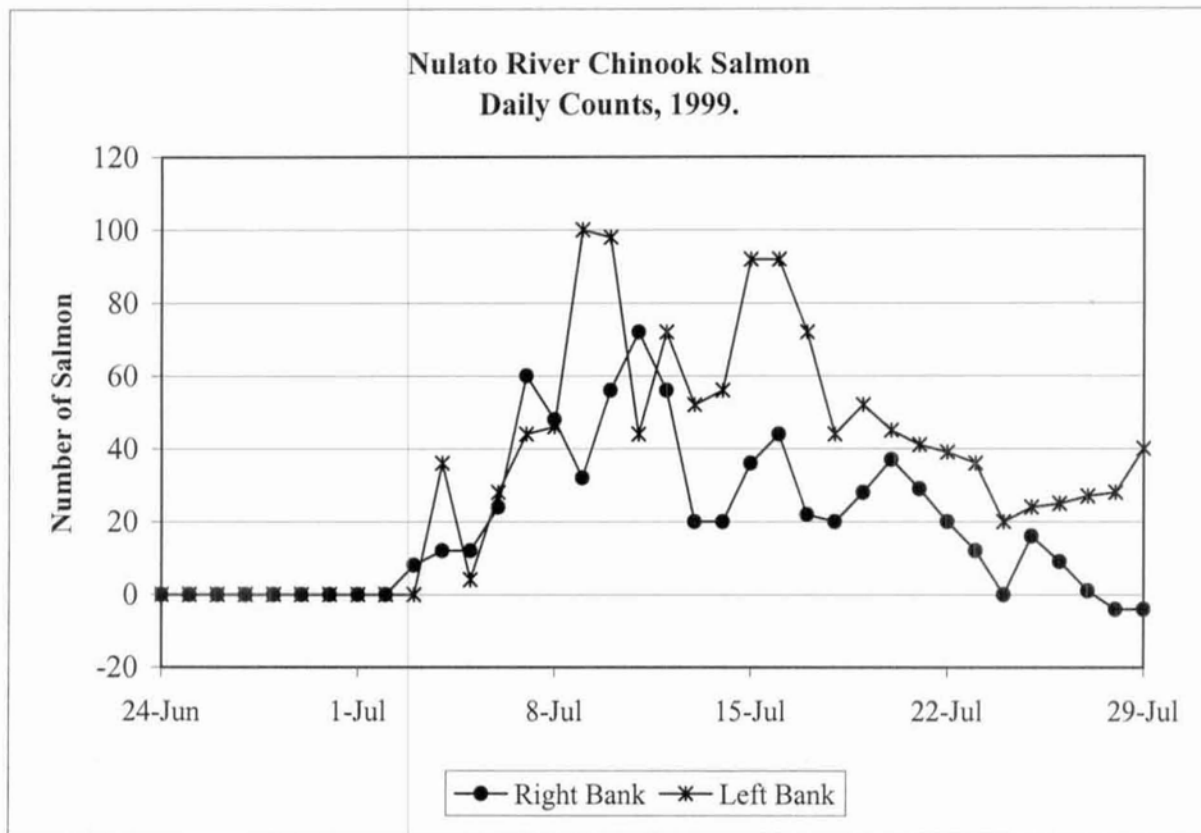


Figure 3. Nulato River chinook and summer chum salmon estimated daily counts by bank, 1999.

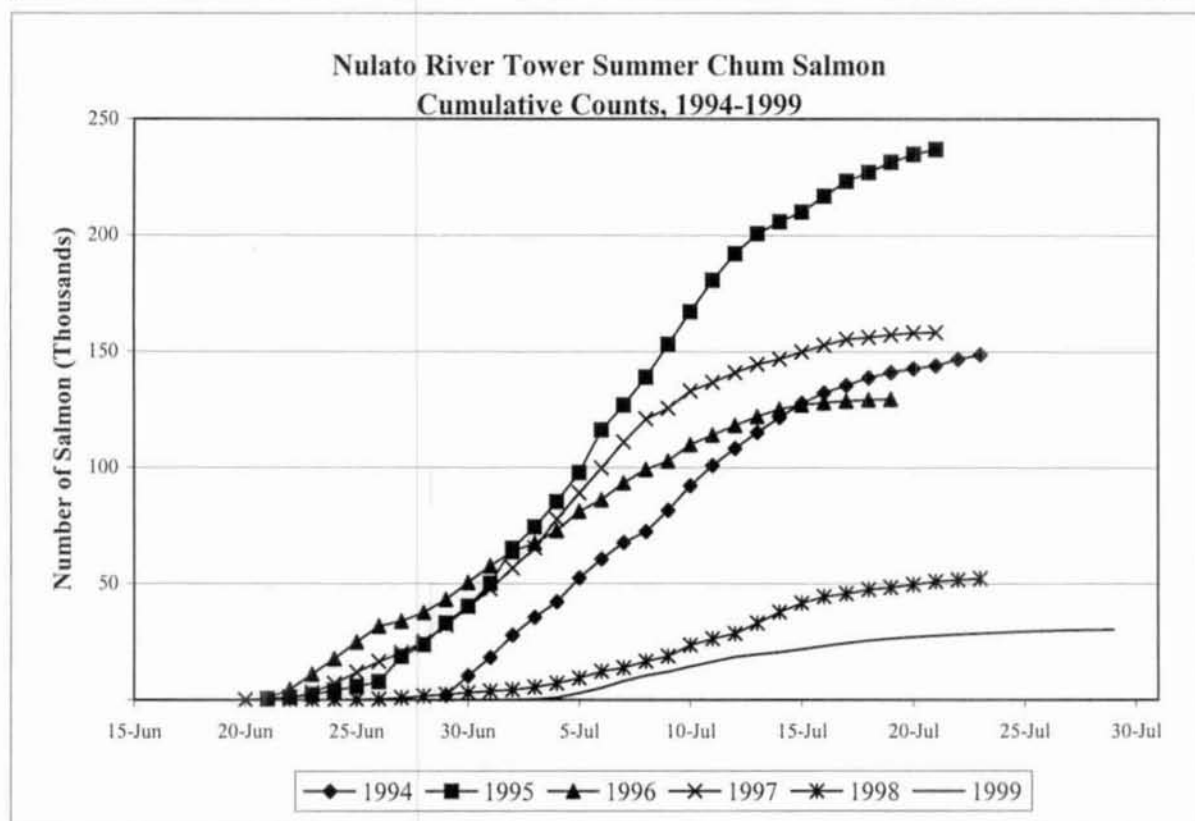
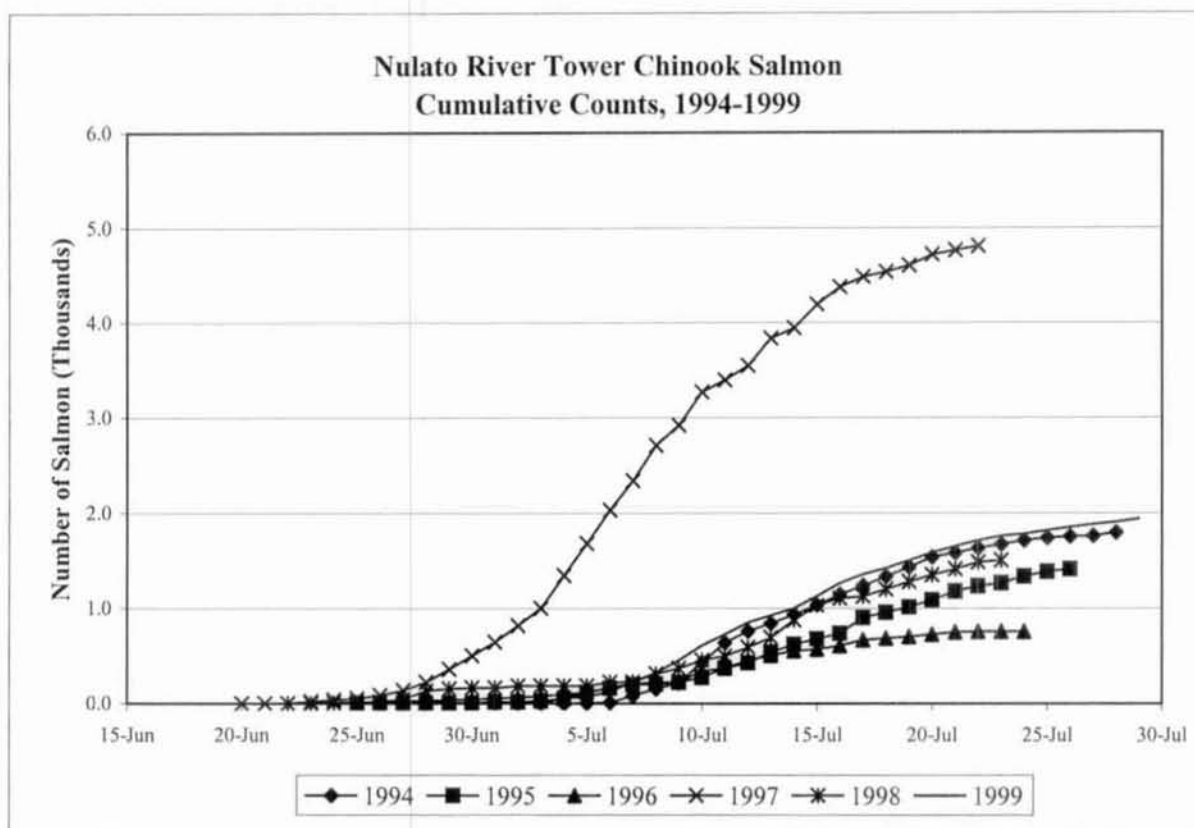
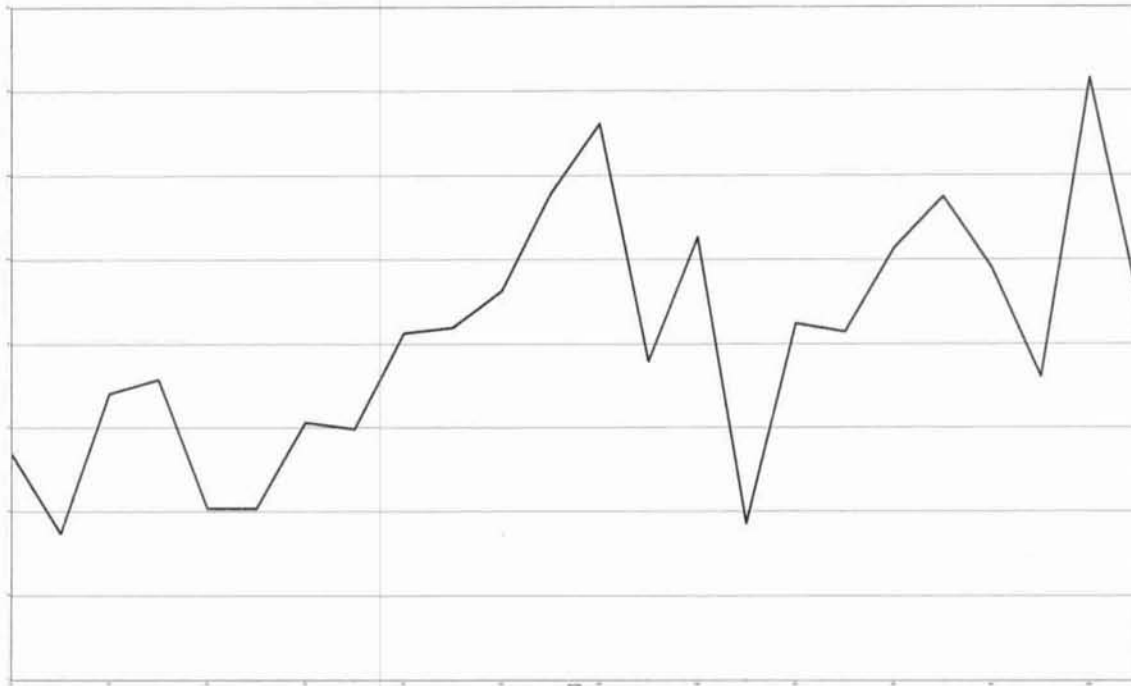


Figure 4. Nulato River chinook and summer chum salmon cumulative counts, 1994-1999.

**Nulato River Chinook Salmon
Hourly Counts, 1999**



**Nulato River Summer Chum Salmon
Hourly Counts, 1999**

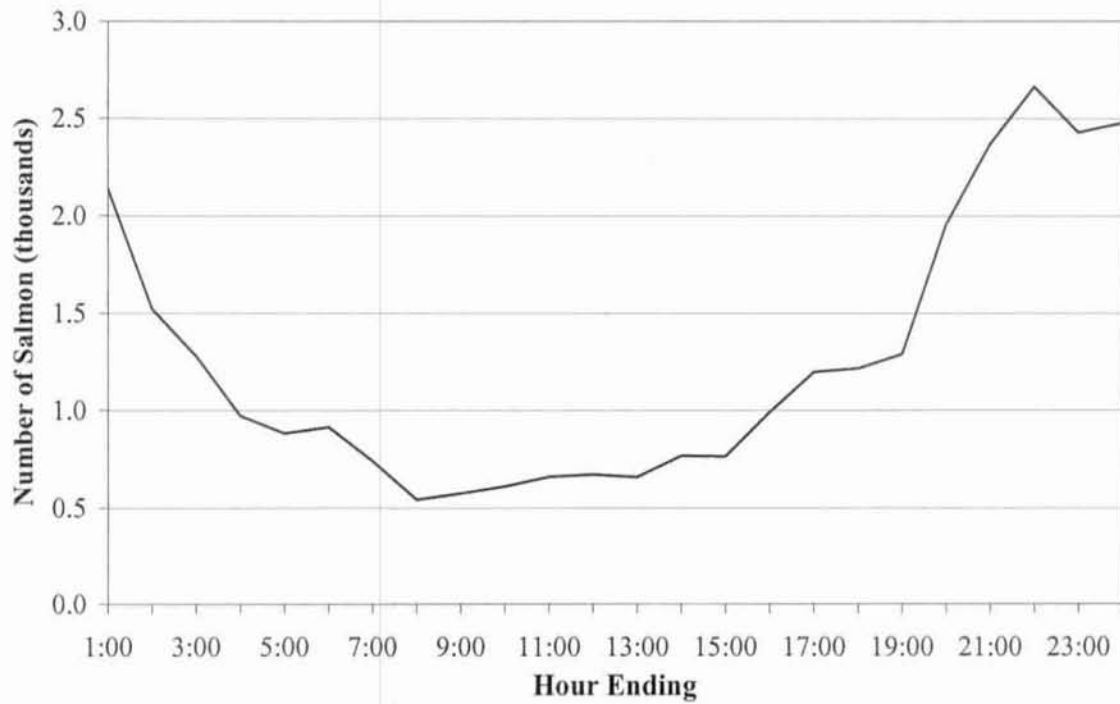


Figure 5. Nulato River chinook and summer chum salmon estimated daily counts by hour, 1999.

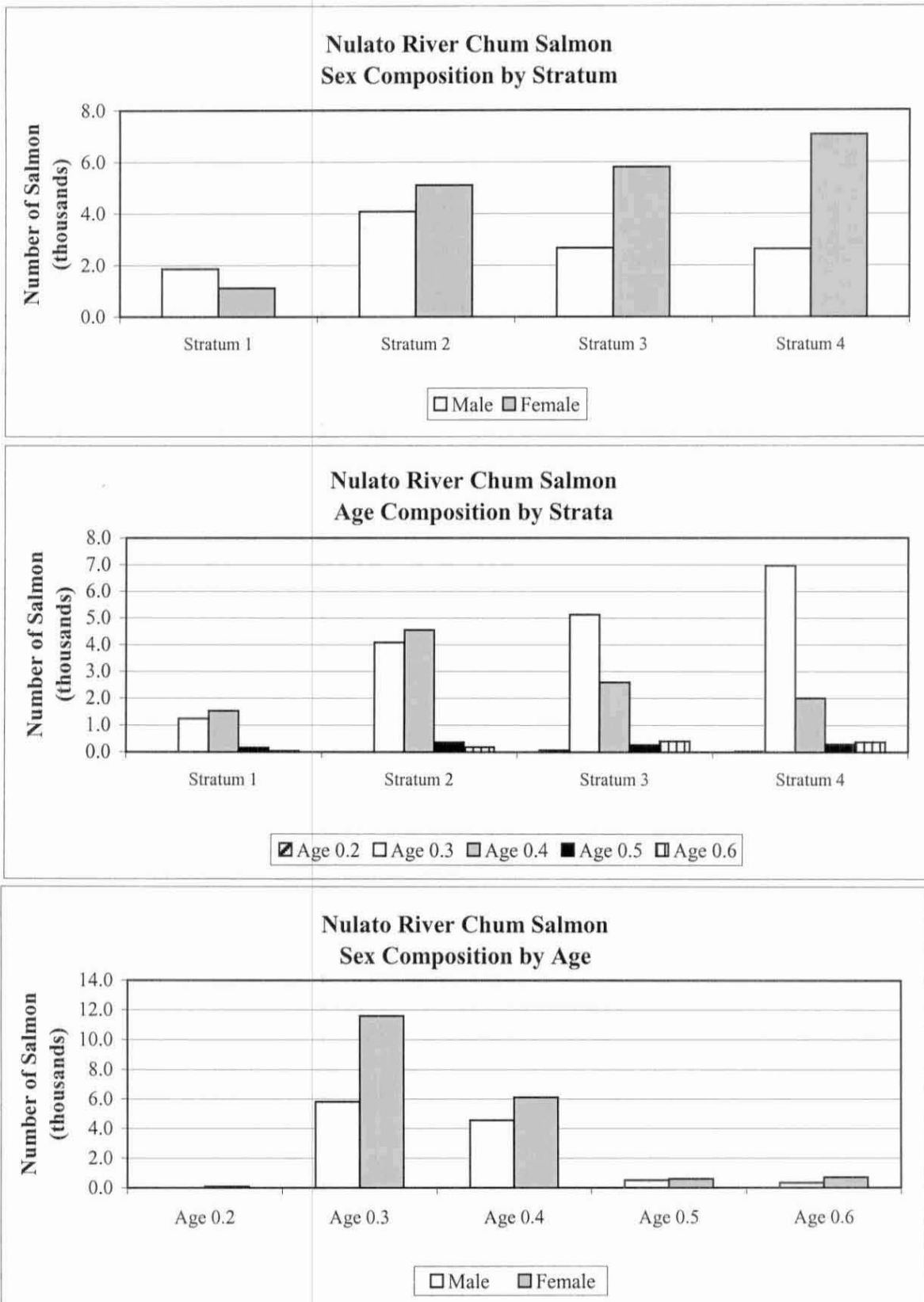


Figure 6. Nulato River summer chum salmon age and sex composition by stratum, and sex composition by age group, 1999.

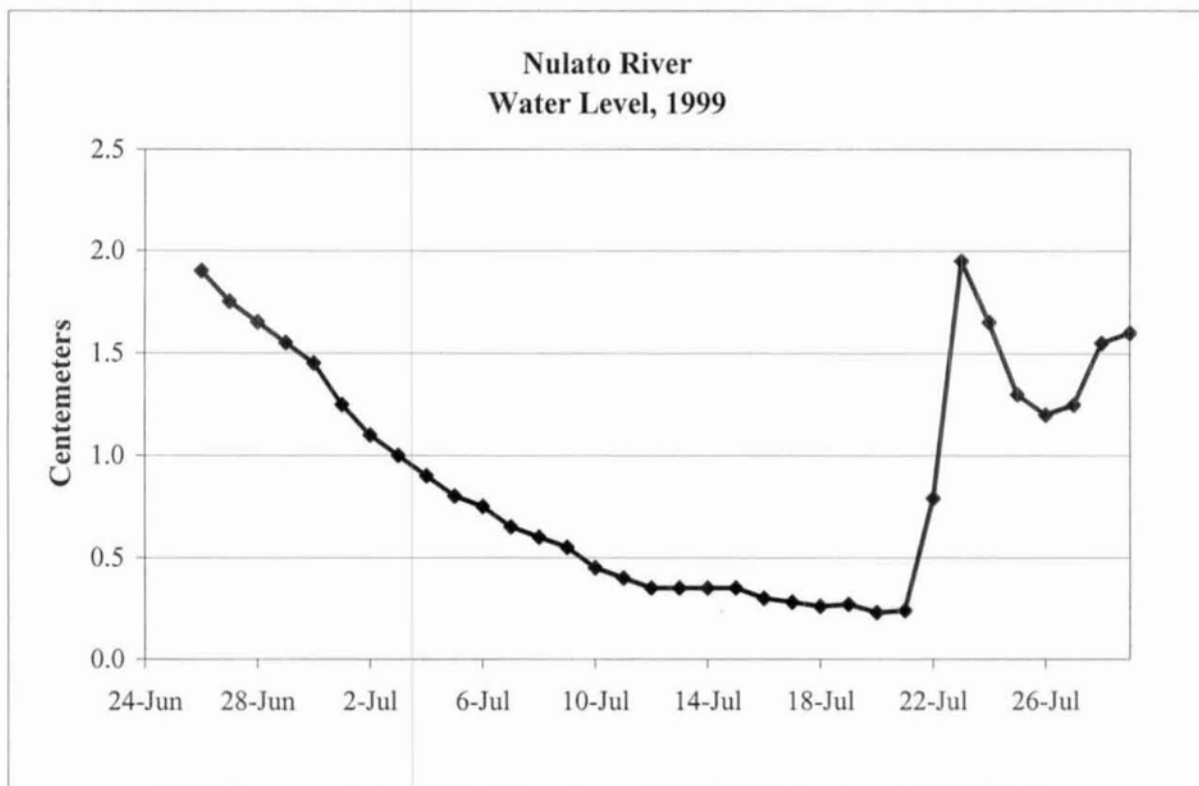
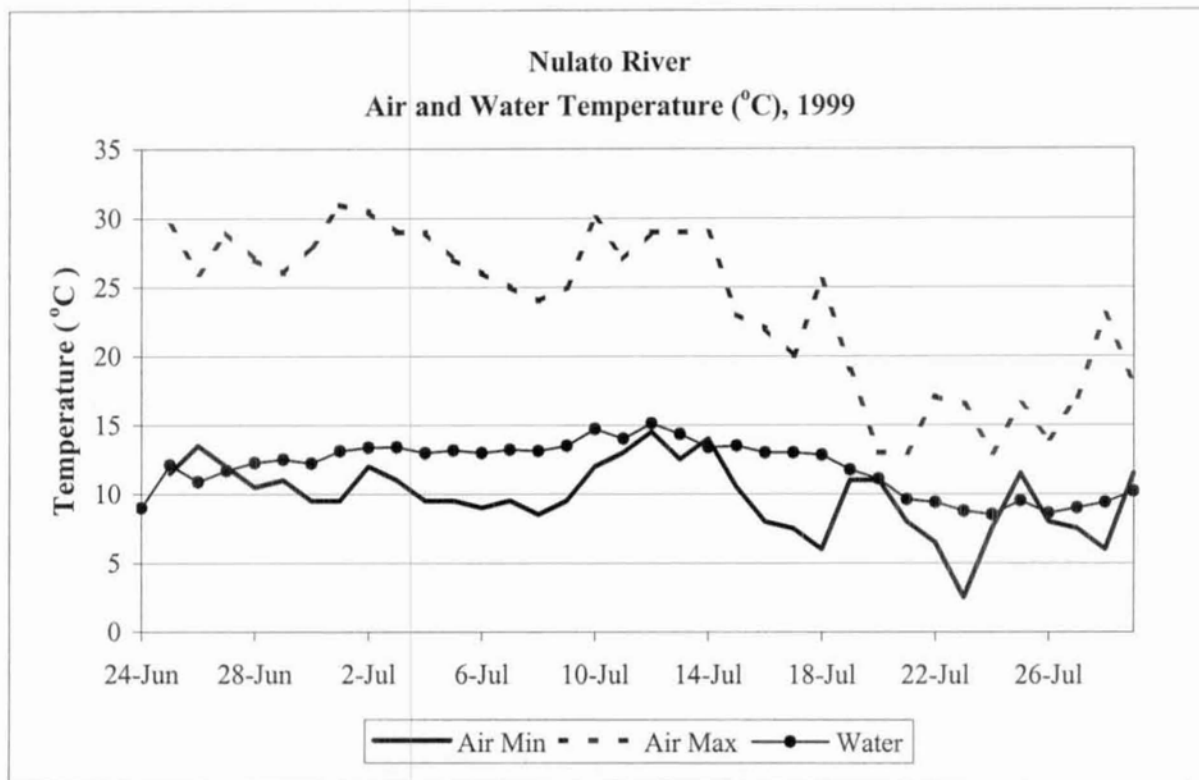


Figure 7. Nulato River tower escapement project climatological and hydrological observations, 1999.

APPENDIX TABLES

Nulato River Tower Project Field Purchase Record

[illegible]

Nulato River Tower Project Hourly Tower Count Data Log

Date	Time			Chum Salmon			Chinook Salmon		
	Start	Stop	Minutes Counted	Up Stream	Dn Stream	Net	Up Stream	Dn Stream	Net
OBSERVER									

Comments:

Appendix A.3. Nulato River tower project hourly salmon counts.

Nulato River Tower Project Hourly Salmon Counts, Date____, Year____.

Right Bank (gravel-bar side)							Left Bank (cut-bank side)						Total Both Banks	
Hour Ending			Chum		Chinook		Minutes Counted	Expansion Factor ^a	Chum		Chinook		Chum	Chinook
	Minutes Counted	Expansion Factor ^a	Actual Counts	Expanded Counts	Actual Counts	Expanded Counts			Actual Counts	Expanded Counts	Actual Counts	Expanded Counts	Expanded Counts	Expanded Counts
0100														
0200														
0300														
0400														
0500														
0600														
0700														
0800														
0900														
1000														
1100														
1200														
1300														
1400														
1500														
1600														
1700														
1800														
1900														
2000														
2100														
2200														
2300														
2400														
Total														
													100.0%	100.0%

^a Hourly expansion factor = [60/(number of minutes counted)]

30

[illegible]

[illegible]32

Appendix B.1. Right bank Nulato River expanded chinook salmon tower counts by hour and date, 1999.

									Hourly Counts (hour ending)																
Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00	Total
24-Jun														0	0	0	0	0	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Jul	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	8
4-Jul	0	4	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
5-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	0	0	0	0	12
6-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	8	0	8	4	0	24
7-Jul	0	4	0	0	0	0	0	0	0	12	0	0	4	0	4	4	4	4	8	8	4	0	4	0	60
8-Jul	0	0	24	0	0	4	4	0	0	0	0	0	0	4	4	0	0	0	0	4	4	0	0	0	48
9-Jul	0	0	0	0	0	0	4	0	0	4	4	0	4	0	0	0	8	0	4	0	4	0	0	0	32
10-Jul	0	0	0	0	0	0	0	0	0	12	4	0	12	4	4	0	4	8	0	8	0	0	0	0	56
11-Jul	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	12	24	16	4	0	4	4	72
12-Jul	0	0	4	0	4	0	0	0	0	0	8	0	0	4	12	0	8	0	4	4	8	0	0	0	56
13-Jul	4	0	0	8	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4	0	0	0	0	20
14-Jul	0	0	0	0	0	0	0	0	0	0	0	4	0	4	0	0	0	4	4	4	0	0	0	0	20
15-Jul	0	0	4	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	8	0	0	16	0	0	36
16-Jul	0	0	0	0	0	4	0	0	0	0	12	-4	0	0	8	4	0	0	4	4	4	4	0	4	44
17-Jul	0	0	0	0	0	0	4	2	0	0	0	0	4	0	4	0	0	0	0	0	0	4	0	4	22
18-Jul	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	4	0	0	0	0	0	0	8	0	20
19-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	8	0	16	0	28
20-Jul	0	0	0	4	0	0	0	4	4	0	0	8	8	0	0	0	0	0	0	4	0	0	4	1	37
21-Jul	0	0	2	0	0	1	1	1	0	1	1	1	1	1	2	1	2	2	3	3	2	2	2	1	29
22-Jul	0	0	1	0	0	0	0	0	0	1	1	1	1	1	1	0	1	1	2	2	1	1	1	0	20
23-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	4	12
24-Jul	0	-4	-4	0	0	0	0	4	4	0	0	0	0	0	0	-4	4	0	0	0	0	0	0	0	0
25-Jul	0	0	0	4	0	0	0	0	0	-4	0	8	0	0	0	4	0	4	0	0	0	0	0	0	16
26-Jul	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	0	9
27-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
28-Jul	0	0	0	0	0	0	0	0	0	0	0	-4	4	0	4	0	0	0	0	0	0	-4	-4	0	-4
29-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	-4
Total	4	5	36	17	4	13	13	19	8	26	30	29	42	17	44	13	40	48	66	75	40	32	44	19	686

Appendix B.2. Left bank Nulato River expanded chinook salmon tower counts by hour and date, 1999.

Date	Hourly Counts (hour ending)																								Total
	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00	
24-Jun																	0	0	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Jul	0	0	20	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36
5-Jul	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
6-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	4	8	4	0	4	0	28
7-Jul	0	0	0	0	4	0	0	0	8	0	0	0	0	0	0	4	0	4	0	8	0	0	8	8	44
8-Jul	0	4	0	2	4	4	0	4	0	4	0	8	4	0	4	0	0	0	0	0	0	4	0	4	46
9-Jul	8	0	0	4	4	0	0	-4	8	12	12	4	16	0	8	8	0	4	0	0	4	0	12	0	100
10-Jul	4	-4	0	8	8	0	2	-4	0	4	0	24	4	16	4	0	4	0	0	0	0	8	0	20	98
11-Jul	8	0	4	0	0	0	4	0	0	4	0	0	12	0	0	0	0	0	0	4	4	0	4	0	44
12-Jul	0	4	0	0	0	8	4	4	0	4	4	4	4	0	4	0	8	0	-4	8	8	4	4	4	72
13-Jul	0	4	0	4	0	0	4	4	4	0	12	8	4	4	0	0	0	0	0	0	0	4	0	0	52
14-Jul	0	0	0	0	0	0	12	8	4	0	4	8	4	4	0	0	0	0	8	4	0	0	4	-4	56
15-Jul	4	0	0	0	4	8	4	8	4	0	4	12	0	12	0	4	0	4	0	0	0	4	20	0	92
16-Jul	0	4	0	0	4	0	0	4	4	4	0	0	12	8	8	8	4	4	8	0	4	4	12	0	92
17-Jul	4	0	0	0	0	-4	4	8	4	4	4	0	8	0	4	0	8	0	4	0	0	0	8	16	72
18-Jul	8	0	0	0	0	0	4	0	4	0	0	4	0	8	4	0	4	0	4	-4	0	0	4	4	44
19-Jul	4	0	0	0	0	4	0	0	12	4	4	0	0	0	0	0	0	0	4	0	20	0	0	0	52
20-Jul	4	8	0	4	0	0	0	4	4	4	0	4	4	0	4	0	0	4	0	0	0	0	0	0	45
21-Jul	2	1	1	1	1	1	2	1	2	2	2	3	3	2	2	1	2	1	1	1	2	1	4	2	41
22-Jul	2	1	1	1	1	1	2	1	2	2	2	3	3	2	2	1	2	1	1	1	2	1	3	2	39
23-Jul	0	0	0	8	4	4	0	0	0	4	4	0	0	0	0	0	0	4	4	4	0	0	0	0	36
24-Jul	0	0	0	0	0	0	0	0	0	0	0	0	8	-4	12	0	0	0	0	0	0	0	0	4	20
25-Jul	0	0	4	0	0	0	4	0	0	4	4	0	0	4	4	-12	0	8	0	0	0	0	4	0	24
26-Jul	1	0	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	0	1	1	1	1	2	1	25
27-Jul	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	27
28-Jul	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	8	0	0	0	0	0	0	0	8	28
29-Jul	0	8	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	8	8	4	0	40
Total	49	30	32	55	36	28	48	41	74	57	62	86	90	58	61	24	45	34	36	40	58	40	99	70	1,257

Appendix B.3. Right and left bank Nulato River combined expanded chinook salmon tower counts by hour and date, 1999.

Date	Hourly Counts (hour ending)																								Total
	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00	
24-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-Jul	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	8
4-Jul	0	4	24	16	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48
5-Jul	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4	4	4	4	0	0	0	16
6-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	4	16	4	8	8	0	0	52
7-Jul	0	4	0	0	4	0	0	0	8	12	0	0	4	0	4	8	4	8	8	16	4	0	12	8	104
8-Jul	0	4	24	2	4	8	4	4	0	4	0	8	4	4	8	0	0	0	4	4	4	0	4	0	94
9-Jul	8	0	0	4	4	0	4	-4	8	16	16	4	20	0	8	8	8	4	4	0	8	0	12	0	132
10-Jul	4	-4	0	8	8	0	2	-4	0	16	4	24	16	20	8	0	8	8	0	8	0	8	0	20	154
11-Jul	8	0	4	0	0	0	4	0	0	4	0	4	12	0	0	0	4	12	24	20	8	0	8	4	116
12-Jul	0	4	4	0	4	8	4	4	0	4	12	4	4	4	16	0	16	0	0	12	16	4	4	4	128
13-Jul	4	4	0	12	0	0	4	4	4	0	12	8	8	4	0	0	0	0	4	0	4	0	0	0	72
14-Jul	0	0	0	0	0	0	12	8	4	0	4	12	4	8	0	0	0	4	12	8	0	0	4	-4	76
15-Jul	4	0	4	0	4	8	4	8	4	0	4	16	0	12	0	4	0	8	8	0	0	20	20	0	128
16-Jul	0	4	0	0	4	4	0	4	4	4	12	-4	12	8	16	12	4	4	12	4	8	8	12	4	136
17-Jul	4	0	0	0	0	-4	8	10	4	4	4	0	12	0	8	0	8	0	4	0	0	4	8	20	94
18-Jul	8	0	0	0	0	0	4	4	4	0	0	8	0	8	4	4	4	0	4	-4	0	0	12	4	64
19-Jul	4	0	0	0	0	4	0	0	12	4	4	0	0	0	0	0	0	4	4	0	28	0	16	0	80
20-Jul	4	8	0	8	0	0	1	8	8	4	0	12	12	0	4	0	0	4	0	4	0	0	4	1	82
21-Jul	2	1	3	2	1	1	2	2	2	3	4	4	4	3	3	2	3	3	4	4	4	3	5	3	70
22-Jul	2	1	2	2	1	1	2	2	2	3	3	4	4	3	3	1	3	2	3	3	3	2	5	3	59
23-Jul	0	0	0	8	4	4	0	0	0	4	4	0	0	0	0	0	4	4	4	4	0	0	4	4	48
24-Jul	0	-4	-4	0	0	0	0	4	4	0	0	0	8	-4	12	-4	4	0	0	0	0	0	0	-4	20
25-Jul	0	0	4	4	0	0	4	0	0	0	4	8	0	4	4	-8	0	12	0	0	0	0	4	0	40
26-Jul	1	0	2	1	1	1	1	1	1	1	1	2	2	1	2	1	2	1	2	2	2	2	3	1	34
27-Jul	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	2	28
28-Jul	0	0	0	0	0	0	0	0	12	0	0	-4	4	0	4	8	0	0	0	0	0	-4	-4	8	24
29-Jul	0	8	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	8	8	4	0	36
Total	54	35	68	72	41	41	61	60	82	84	93	116	132	76	105	37	85	83	103	115	98	72	143	89	1,943

Appendix B.4. South bank Nulato River expanded summer chum salmon tower counts by hour and date, 1999.

Date	Hourly Counts (hour ending)																								Total
	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00	
24-Jun																	0	0	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4
2-Jul	0	0	8	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	0	0	0	0	16
3-Jul	0	0	0	4	0	0	0	0	4	0	0	0	4	4	0	0	8	4	12	0	0	0	0	4	44
4-Jul	8	12	32	20	0	20	4	0	8	0	0	4	0	0	0	4	8	0	0	8	8	20	44	88	288
5-Jul	96	104	56	88	76	0	0	0	8	0	0	4	0	0	16	32	24	0	56	0	76	76	196	64	972
6-Jul	60	152	44	20	12	8	8	8	4	4	8	0	20	16	8	20	40	36	40	124	108	100	48	52	940
7-Jul	152	44	4	28	0	68	44	8	36	4	44	24	36	40	8	12	48	28	80	140	112	176	236	48	1,420
8-Jul	56	28	108	22	0	16	4	0	0	8	16	4	24	44	36	0	16	48	148	40	44	76	132	80	950
9-Jul	96	8	48	16	0	24	8	20	8	16	4	44	36	28	48	52	16	8	28	136	192	64	20	32	952
10-Jul	44	72	100	76	64	48	20	12	0	128	40	20	24	16	12	28	40	76	32	92	60	116	12	44	1,176
11-Jul	64	12	24	44	16	0	8	20	12	12	36	44	36	28	64	60	56	76	68	88	76	68	76	80	1,068
12-Jul	20	40	52	24	24	20	28	12	16	12	16	16	20	20	16	28	72	64	96	112	144	100	40	24	1,016
13-Jul	24	32	20	24	12	4	16	32	12	12	12	36	4	12	8	24	20	16	80	40	0	84	32	40	596
14-Jul	20	8	0	12	20	20	28	4	20	8	16	12	4	24	24	28	36	36	32	32	28	32	52	24	520
15-Jul	0	8	0	36	88	136	48	16	16	8	28	16	16	24	16	20	24	12	20	60	40	96	28	28	784
16-Jul	52	16	28	12	4	28	24	16	20	12	36	12	40	32	56	28	72	52	32	20	124	28	24	60	828
17-Jul	72	40	24	16	24	4	28	22	16	16	12	4	4	20	12	24	44	28	36	56	48	64	22	28	664
18-Jul	12	8	4	40	-4	4	16	28	12	12	16	28	16	12	24	40	52	32	40	52	20	28	20	56	568
19-Jul	8	12	12	12	28	16	4	16	4	44	4	12	0	32	16	32	24	12	32	4	40	16	64	20	464
20-Jul	20	8	16	12	19	20	24	8	8	12	20	16	0	8	12	-4	12	20	8	44	12	24	36	22	377
21-Jul	20	15	14	13	9	11	7	5	5	8	7	7	7	9	9	11	15	13	21	26	28	29	27	20	337
22-Jul	18	13	13	11	8	9	6	5	4	7	6	6	6	8	8	10	13	12	18	23	25	26	23	17	296
23-Jul	4	8	12	12	0	8	20	16	12	16	8	20	12	24	16	8	8	4	4	0	0	28	4	12	256
24-Jul	0	4	32	24	16	24	40	40	28	16	32	12	4	8	4	-4	0	16	4	8	4	4	4	0	320
25-Jul	32	12	-4	-4	24	24	8	24	16	32	12	36	20	16	8	24	4	12	4	0	-8	8	0	4	304
26-Jul	14	11	10	9	6	7	5	4	3	5	5	5	5	6	7	8	10	9	15	18	20	20	19	14	235
27-Jul	10	7	7	6	5	5	4	3	2	4	4	3	3	4	5	5	7	7	10	13	14	14	13	10	165
28-Jul	12	0	4	0	16	4	0	0	8	0	0	0	0	8	0	8	8	0	4	4	12	0	8	0	96
29-Jul	4	24	0	4	8	0	8	0	0	-8	4	0	0	-4	0	0	0	8	8	0	24	0	0	4	84
Total	917	698	668	580	475	528	410	319	283	387	386	386	338	439	441	498	670	633	920	1,155	1,251	1,297	1,184	874	15,740

Appendix B.5. Left bank Nulato River expanded summer chum salmon tower counts by hour and date, 1999.

Date	Hourly Counts (hour ending)																								Total
	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00	
24-Jun																	0	0	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	16	0	20
2-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4	0	0	0	0	0	0	0	0	-4
3-Jul	0	0	0	0	0	0	0	0	0	-4	4	0	0	8	0	0	12	8	8	24	28	44	28	52	212
4-Jul	16	24	28	20	0	8	4	0	0	16	0	0	16	8	12	28	12	24	32	28	8	32	28	88	432
5-Jul	120	136	0	48	28	4	4	8	20	12	24	8	24	0	12	52	40	56	36	56	40	24	76	164	992
6-Jul	120	8	20	32	0	8	4	0	0	4	0	8	8	24	32	28	28	40	8	96	224	192	224	172	1,280
7-Jul	136	80	128	16	24	44	0	4	8	12	28	12	20	0	16	52	20	48	24	172	192	96	160	164	1,456
8-Jul	92	44	48	14	32	24	0	0	0	4	12	20	0	32	24	44	32	32	36	68	124	240	156	340	1,418
9-Jul	96	124	48	12	40	20	12	20	12	4	4	8	4	52	16	32	12	52	12	36	76	36	16	20	764
10-Jul	20	96	92	72	24	32	22	36	24	16	24	4	28	20	28	16	56	32	28	16	24	72	40	124	946
11-Jul	164	100	76	56	116	64	32	0	16	12	16	24	28	20	12	20	20	52	24	20	24	44	36	52	1,028
12-Jul	104	16	32	24	12	28	16	28	28	16	16	40	44	32	24	40	56	36	8	76	52	188	88	72	1,076
13-Jul	64	28	24	0	16	12	16	12	4	12	16	28	36	8	16	32	16	12	8	12	12	88	20	52	544
14-Jul	20	20	12	4	24	8	24	20	24	20	12	16	16	8	8	16	52	12	12	28	48	20	32	32	488
15-Jul	20	4	0	16	8	32	52	12	16	8	20	20	12	8	8	16	16	28	8	12	24	40	60	72	512
16-Jul	64	16	12	0	12	8	0	20	28	12	16	20	12	20	32	24	20	28	12	36	36	44	32	0	504
17-Jul	24	32	24	8	8	12	44	4	24	16	16	4	8	12	12	12	52	28	40	36	24	20	48	32	540
18-Jul	20	16	12	-16	4	8	12	0	24	8	12	4	20	20	24	40	20	36	24	28	56	44	64	52	532
19-Jul	28	4	12	12	16	16	32	12	32	16	24	20	12	20	20	4	12	24	12	16	40	16	20	28	448
20-Jul	20	8	8	12	8	20	6	12	8	16	-8	12	4	12	4	8	16	0	12	-4	28	52	20	0	273
21-Jul	21	14	11	6	7	6	5	3	5	3	5	4	5	5	5	8	9	10	6	14	19	23	21	28	245
22-Jul	18	12	9	5	6	5	5	3	4	3	4	4	5	5	5	7	8	9	5	13	17	20	19	25	217
23-Jul	0	12	8	12	12	8	24	4	0	12	12	20	8	12	12	4	0	8	0	0	0	12	4	4	188
24-Jul	28	4	0	0	4	4	8	8	0	4	12	8	0	-4	4	8	4	0	0	0	0	4	0	4	100
25-Jul	8	12	0	20	4	8	4	16	0	0	4	0	8	0	0	-4	0	0	0	0	0	0	4	0	84
26-Jul	6	4	3	2	2	2	2	1	1	1	1	1	2	2	2	3	3	3	2	4	6	7	7	9	76
27-Jul	6	4	3	2	2	2	1	1	1	1	1	1	1	2	2	2	2	3	2	4	5	6	6	8	68
28-Jul	0	0	0	8	0	4	0	0	12	0	0	0	0	0	0	4	4	0	8	4	4	0	8	4	60
29-Jul	4	4	0	8	0	0	4	0	0	0	0	0	0	0	4	-4	0	0	0	4	4	0	12	4	44
Total	1,219	822	610	393	408	387	332	224	292	224	275	287	321	329	326	493	526	581	367	799	1,115	1,365	1,245	1,602	14,543

Appendix B.6. Right and left bank Nulato River combined expanded summer chum salmon tower counts by hour and date, 1999.

									Hourly Counts (hour ending)																	
Date	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00	Total	
24-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
28-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
29-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
30-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	20	0	24	
2-Jul	0	0	8	0	0	0	0	0	0	0	0	0	0	4	-4	0	0	0	4	0	0	0	0	0	12	
3-Jul	0	0	0	4	0	0	0	0	4	-4	4	0	0	12	4	0	12	16	12	36	28	44	28	56	256	
4-Jul	24	36	60	40	0	28	8	0	8	16	0	4	16	8	12	32	20	24	32	36	16	52	72	176	720	
5-Jul	216	240	56	136	104	4	4	8	28	12	24	12	24	0	28	84	64	56	92	56	116	100	272	228	1,964	
6-Jul	180	160	64	52	12	16	12	8	4	8	8	8	28	40	40	48	68	76	48	220	332	292	272	224	2,220	
7-Jul	288	124	132	44	24	112	44	12	44	16	72	36	56	40	24	64	68	76	104	312	304	272	396	212	2,876	
8-Jul	148	72	156	36	32	40	4	0	0	12	28	24	24	76	60	44	48	80	184	108	168	316	288	420	2,368	
9-Jul	192	132	96	28	40	44	20	40	20	20	8	52	40	80	64	84	28	60	40	172	268	100	36	52	1,716	
10-Jul	64	168	192	148	88	80	42	48	24	144	64	24	52	36	40	44	96	108	60	108	84	188	52	168	2,122	
11-Jul	228	112	100	100	132	64	40	20	28	24	52	68	64	48	76	80	76	128	92	108	100	112	112	132	2,096	
12-Jul	124	56	84	48	36	48	44	40	44	28	32	56	64	52	40	68	128	100	104	188	196	288	128	96	2,092	
13-Jul	88	60	44	24	28	16	32	44	16	24	28	64	40	20	24	56	36	28	88	52	12	172	52	92	1,140	
14-Jul	40	28	12	16	44	28	52	24	44	28	28	28	20	32	32	44	88	48	44	60	76	52	84	56	1,008	
15-Jul	20	12	0	52	96	168	100	28	32	16	48	36	28	32	24	36	40	40	28	72	64	136	88	100	1,296	
16-Jul	116	32	40	12	16	36	24	36	48	24	52	32	52	52	88	52	92	80	44	56	160	72	56	60	1,332	
17-Jul	96	72	48	24	32	16	72	26	40	32	28	8	12	32	24	36	96	56	76	92	72	84	70	60	1,204	
18-Jul	32	24	16	24	0	12	28	28	36	20	28	32	36	32	48	80	72	68	64	80	76	72	84	108	1,100	
19-Jul	36	16	24	24	44	32	36	28	36	60	28	32	12	52	36	36	36	36	44	20	80	32	84	48	912	
20-Jul	40	16	24	24	27	40	30	20	16	28	12	28	4	20	16	4	28	20	20	40	40	76	56	22	650	
21-Jul	40	29	25	18	16	17	12	9	10	11	12	11	12	14	15	19	24	24	27	40	48	52	48	48	582	
22-Jul	36	26	22	16	14	15	11	8	9	10	10	10	11	13	13	17	21	21	24	35	42	46	42	42	513	
23-Jul	4	20	20	24	12	16	44	20	12	28	20	40	20	36	28	12	8	12	4	0	0	40	8	16	444	
24-Jul	28	8	32	24	20	28	48	48	28	20	44	20	4	4	8	4	4	16	4	8	4	8	4	4	420	
25-Jul	40	24	-4	16	28	32	12	40	16	32	16	36	28	16	8	20	4	12	4	0	-8	8	4	4	388	
26-Jul	20	15	13	11	9	9	7	5	5	6	6	6	7	8	8	10	13	13	16	22	26	27	25	22	311	
27-Jul	15	11	10	8	6	7	5	4	4	5	5	5	5	6	6	8	10	9	12	17	19	21	19	17	233	
28-Jul	12	0	4	8	16	8	0	0	20	0	0	0	0	8	0	12	12	0	12	8	16	0	16	4	156	
29-Jul	8	28	0	12	8	0	12	0	0	-8	4	0	0	0	0	-4	0	0	8	8	4	28	0	12	8	128
Total	2,136	1,521	1,278	973	884	915	743	543	575	611	662	673	659	769	767	990	1,196	1,215	1,287	1,954	2,367	2,662	2,428	2,476	30,283	

Appendix C. Nulato River summer chum salmon age and sex composition by stratum and weighted season total, 1999.

Strata Dates	Sample Size			Brood Year and (Age Group)					Total
				1996 (0.2)	1995 (0.3)	1994 (0.4)	1993 (0.5)	1992 (0.6)	
June 22-July 5	72	Males	No. in Escapement	0	785	992	83	0	1,860
			Percent of Sample	0	26.4	33.3	2.8	0.0	62.5
		Females	No. in Escapement	0	455	537	83	41	1,116
			Percent of Sample	0	15.3	18.1	2.8	1.4	37.5
		Subtotal	No. in Escapement	0	1,240	1,529	166	41	2,976
			Percent of Sample	0.0	41.7	51.4	5.6	1.4	100.0
July 6-9	99	Males	No. in Escapement	0	1,669	2,226	185	0	4,080
			Percent of Sample	0	18.2	24.2	2.0	0.0	44.4
		Females	No. in Escapement	0	2,411	2,319	185	185	5,100
			Percent of Sample	0	26.3	25.3	2.0	2.0	55.6
		Subtotal	No. in Escapement	0	4,080	4,545	370	185	9,180
			Percent of Sample	0.0	44.4	49.5	4.0	2.0	100.0
July 10-14	124	Males	No. in Escapement	0	1,638	750	136	136	2,660
			Percent of Sample	0	19.4	8.9	1.6	1.6	31.5
		Females	No. in Escapement	68	3,479	1,842	136	273	5,798
			Percent of Sample	0.8	41.1	21.8	1.6	3.2	68.6
		Subtotal	No. in Escapement	68	5,117	2,592	272	409	8,458
			Percent of Sample	0.8	60.5	30.7	3.2	4.8	100.0
July 15-25	358	Males	No. in Escapement	0	1,728	594	108	189	2,619
			Percent of Sample	0	17.9	6.1	1.1	2.0	27.1
		Females	No. in Escapement	27	5,239	1,406	189	189	7,050
			Percent of Sample	0.27933	54.2	14.5	2.0	2.0	72.9
		Subtotal	No. in Escapement	27	6,967	2,000	297	378	9,669
			Percent of Sample	0.3	72.1	20.7	3.1	3.9	100.0
Seasonal	653	Males	No. in Escapement	0	5,820	4,562	512	325	11,219
			Percent of Sample	0.0	19.2	15.1	1.7	1.1	37.0
		Females	No. in Escapement	95	11,584	6,104	593	688	19,064
			Percent of Sample	0.3	38.3	20.2	2.0	2.3	63.0
		Total	No. in Escapement	95	17,404	10,666	1,105	1,013	30,283
			Percent of Sample	0.3	57.5	35.3	3.7	3.4	100.0